The activity projections presented in this working paper are used to determine the role of airports within the MAG system, to evaluate the ability of the existing system to accommodate projected aviation demand, and to plan future airside and landside facilities for the system. Development of a comprehensive regional plan for the public use airports in the MAG system requires a general understanding of recent and anticipated trends in the aviation industry as a whole. National, regional, and statewide trends can provide insight into the development of aviation activity projections for the airports in MAG's system. A review of the trends within the aviation industry that could specifically impact the use of commercial service and general aviation are of primary importance. Some aviation industry trends will undoubtedly have a greater impact on MAG airports than others. There is also the possibility that some anticipated trends discussed in this working paper might have no pronounced impact on the region's aviation environment.

The following sections discuss recent and ongoing aviation industry trends, the projections of aviation demand, and the effects of the aviation industry trends on the projections of aviation demand. The working paper is delineated as follows:

- **Industry Trends**

- *Recent Commercial Trends*
- *Anticipated Commercial Trends*
- *Trends Affecting Commercial Aviation*
- *Trends Affecting General Aviation Activity*
- *MAG Aviation Trends*

- **Projections of MAG Aviation Demand**

- *Forecast Assumptions*
- *Based Aircraft Projections*
- *Total Aviation Operations Projections*
- *Commercial Air Service Projections*

INDUSTRY TRENDS

Trends in the commercial airline industry could substantially impact air service in Phoenix, particularly as they relate to how the region's demand for commercial airline travel will be served in the future. General aviation trends are also important to consider since every airport in the MAG system, even the air carrier airport, accommodates some segment of general aviation activity. Furthermore, the vast majority of MAG airports accommodate only general aviation aircraft operations. An understanding of general aviation trends is important in considering the future demand for this component of the industry. A discussion of the changing patterns in the business use of general aviation aircraft is an important element in the examination of general aviation trends.

Trends presented in this working paper are generally for the U.S. as a whole, and are intended to provide a general frame of reference for the reader. The analysis of these trends provides an understanding of how

aviation activity within the MAG region compares to aviation activity throughout the country. This analysis also establishes a basis for predicting how aviation activity may be expected to grow and change in the future. This frame of reference is essential when identifying viable alternatives for improving MAG's future airport system.

Recent Commercial Trends

The airline industry operates in a continual state of adjustment and change. During the last 20 years, the United States has experienced unprecedented expansion of air carrier capacity. There have been large investments by the major carriers to control the flow of traffic through networks of hub airports. There have been documented skirmishes between the major carriers and new entrants in a number of markets where an established carrier has tried to fend off incursions by rival new entrants. Airline passengers have been rewarded with low airfares where competition has prevailed. In some instances, competition resulted in low fares until such time that a new entrant was either driven out or failed. Subsequently, fares returned to their previous (higher) levels. As a result, at single-carrier hubs and many local airports, passengers pay, on average, much higher fares.

In the late 1980s, air carriers lost millions of dollars. Those losses had a profound effect on the way airlines operated. Some of the most dramatic changes that occurred included the sudden and complete shutdown of several hub operations and the demise of several flagship carriers, notably Eastern Airlines, Braniff, and Pan Am.

The 1990s ushered in a new period of mergers, global alliances, and joint marketing agreements, as well as domestic alliances between major and regional carriers. In addition, there have been significant structural changes in the way airlines conduct business. The airlines have examined every aspect of their operations to reduce costs. A "shifting downstream" of service to smaller communities marked the mid-1990s. The regional carriers, with lower labor costs, came into their own. Shorter haul service to hub airports was turned over to the regional carriers and they provided high frequency, turboprop service to and from their major carrier affiliate's hub airport. For many communities, the turboprops were never fully accepted. As the domestic system solidified, the major carriers have re-entered this segment of the airline business by acquisition of the regional carriers and by replacement of turboprops with regional jets. This process has left smaller cities with few options for air service.

Four major factors that have helped to shape the development of today's commercial airline industry are as follows:

- A robust, but cyclical economy – Trends in commercial passenger boardings, when compared to the U.S. Gross Domestic Product (GDP), indicate a direct relationship between periods of GDP growth and decline to periods of increases and decreases in the total number of U.S. commercial passenger boardings. These trends clearly indicate that the airline industry and commercial passenger traffic are significantly impacted by upturns and downturns in the U.S. economy. Since the early 1990s, the steady growth in the U.S. economy has resulted in a lengthy period of significant increases in total commercial passenger traffic.

- Over-expansion of the airline industry in the late 1980s – The over-expansion of the airline industry that was experienced in the late 1980s was a major factor that caused airlines to lose over $13 billion during the early 1990s, the largest losses ever experienced. As a result of these losses, airlines were forced to reevaluate their systems and make the following changes:

    - Implement major adjustments to their route structures, concentrating on the most profitable routes
    - Increase seating capacity and maximize frequencies to achieve higher load factors

- Eliminate secondary connecting hubs and introduce point-to-point service in the larger markets
- Focus on the development of strategic marketing alliances with regional carriers in the U.S. and other airlines abroad
- Rationalize aircraft fleets that, on average, offered lower operating costs

- Widespread adoption of similar, successful strategies by each of the major carriers – The three- to five-year long-term planning horizons under which most airlines operate allow them to observe and quickly emulate the successful strategies of their competitors. This copycat approach to providing air service has resulted in several episodic waves of strategic changes by the airlines. The following are examples of these types of actions that have been taken by most major airlines:

  - Development of hub fortresses to capture and control traffic flows
  - Initiation of frequent flyer programs
  - Emulation of Southwest Airlines
  - Code-sharing alliances with regional carriers
  - Replacement of jets with turboprop or regional jet aircraft
  - Abandonment/reduction of 19-seat aircraft
  - Acquisition of whole or part of code-sharing partners

  Widespread adoption of these strategies has intensified their impact on air service within the U.S.

- Technological advances including computer reservation systems, yield management, and e-commerce – The use of computers has had a profound impact on the air carrier industry from the standpoint of operations, marketing, pricing, and ticket distribution. One of the most significant changes has been the ability of airlines to implement Yield Management Systems that allow them to constantly track price, bookings, and fare information for many airlines. These systems allow airlines to have up-to-the-minute information about passenger demand and fares, which allows their pricing departments to constantly adjust fares, frequently over one million times per day, to adjust the number of seats and airfares to maximize load factors and revenues. In addition, the recent growth in the use electronic and paperless tickets and the direct purchase of tickets from the airlines, as opposed to the traditional travel agent process, has also significantly impacted the industry.

Anticipated Commercial Trends

The preceding descriptions of historic commercial airline trends are the background from which the Federal Aviation Administration (FAA) has developed forecasts of future levels of commercial passenger activity. The most recent forecasts of commercial passenger activity presented by the FAA in *FAA Aerospace Forecasts, Fiscal Years 2001-2012* project anticipated strong growth over the forecast period both in domestic and international passenger activity at U.S. airports.

Commercial passenger enplanements in the U.S. are anticipated to experience sustained growth throughout the forecast period. This growth is based on the FAA's forecast of continued, yet slowing, economic expansion in the U.S. during this period. The FAA projects that total domestic passenger enplanements on large U.S. carriers and regional/commuter carriers combined will increase from approximately 639.1 million in 2000 to approximately 982.9 million in 2012, representing an average annual growth rate of approximately 3.6 percent.

FAA forecasts of international passenger activity are based on the assumption that the world economy (using international GDP as a forecast basis) will grow at a pace that exceeds the U.S. GDP growth over the forecast period. International passenger enplanements on U.S. carriers are therefore projected to increase from approximately 54.6 million in 2000 to approximately 111.0 million in 2012, based on the

higher rate of international GDP growth. This growth represents a relatively robust forecast average annual growth rate of approximately 6.1 percent. Latin American and Pacific markets are expected to represent the strongest growth in total international passenger traffic on U.S carriers, with forecast average annual growth rates of approximately 6.8 percent and 6.2 percent, respectively. The Atlantic market is projected to have an average annual growth rate of approximately 5.2 percent between 2000 and 2012.

Table 2.1 presents a summary of historic passenger enplanement levels at U.S. airports and the FAA's most recent domestic and international passenger enplanement forecasts on U.S. carriers (large air carriers and regional/commuter carriers) for each year in the forecast period.

Table 2.1
Projection of U.S. Carrier Enplanements[1]

Year	Domestic Enplanements (millions)	International Enplanements (millions)	Total Enplanements (millions)
Historical			
1995	531.1	48.6	579.7
1996	558.1	50.0	608.1
1997	579.1	52.3	631.4
1998	590.4	53.1	643.5
1999	612.9	53.3	666.2
2000	639.1	54.6	693.7
Average Annual Growth Rate 1995-2000	***3.8 %***	***2.4 %***	***3.7 %***
Forecast			
2001	657.2	58.1	715.3
2002	678.1	62.1	740.1
2003	702.2	66.4	768.6
2004	728.8	70.8	799.6
2005	757.8	75.2	833.1
2006	788.4	79.6	868.0
2007	818.8	84.1	902.9
2008	849.5	89.1	938.6
2009	881.1	94.3	975.4
2010	913.8	99.8	1,013.5
2011	947.7	105.4	1,053.1
2012	982.9	111.0	1,093.9
Average Annual Growth Rate 2000-2012	***3.6%***	***6.1 %***	***3.9 %***

Source: *FAA Aerospace Forecasts, Fiscal Years 2001 – 2012*

In summary, current FAA forecasts for commercial passenger activity for U.S. carriers project stable and relatively strong growth in both domestic and international enplanements at U.S. airports. Domestic passenger enplanements are projected to increase at an average annual rate of approximately 3.6 percent from 2000 to 2012, slightly below the growth rate experienced at U.S. airports between 1995 and 2000.

[1] The FAA bases all forecasts on fiscal years, rather than calendar years as reported by the airports. All FAA data is presented in terms of fiscal years, while all airport data is presented in calendar years.

International passenger enplanements are projected to increase at an average annual rate of approximately 6.1 percent over the forecast period, a rate significantly greater than the 2.4 percent average annual growth rate experienced in international passenger enplanements between 1995 and 2000.

Other factors related to domestic U.S. commercial large air carrier passenger activity identified by the FAA in the *FAA Aerospace Forecasts, Fiscal Years 2001-2012*, include the following:

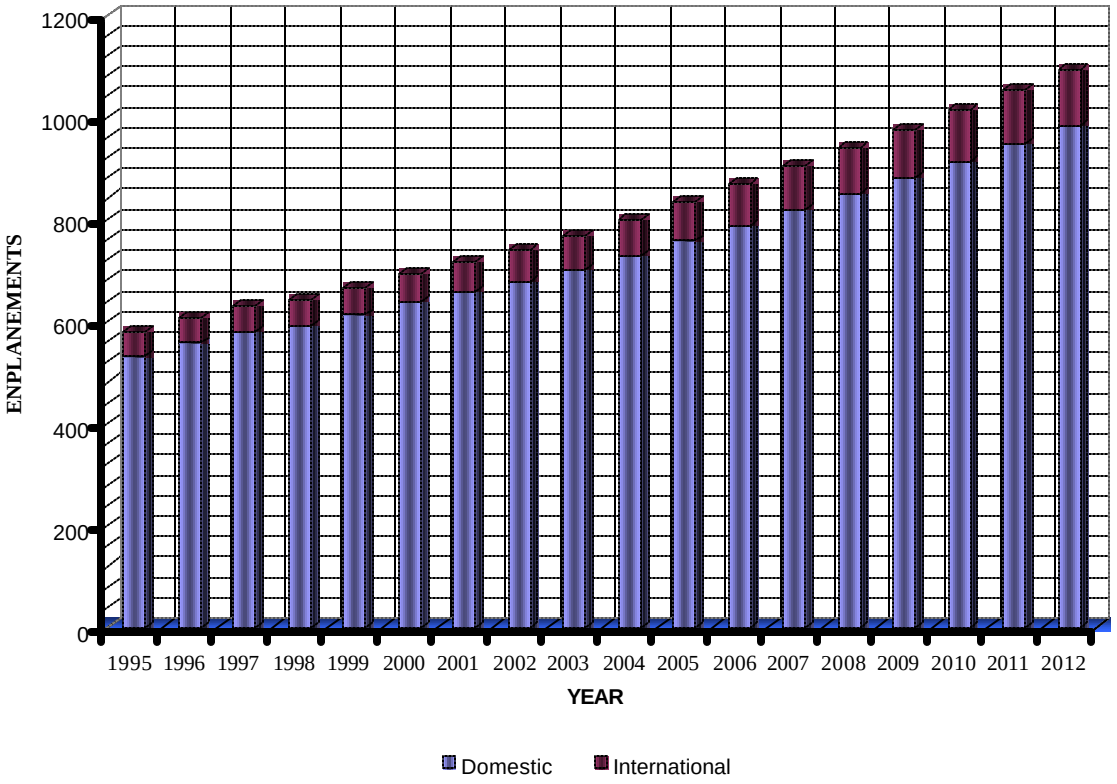
- Between 2000 and 2012, air carrier aircraft operations are projected to increase from 15.2 million to 21.8 million
- Average passenger trip length is expected to increase from 832.3 to 887.3 miles
- Average seats per aircraft departure will increase from 139.3 to 147.4
- Average load factor is expected to drop slightly from 70.9 percent to 70.5 percent

The *FAA Aerospace Forecasts, Fiscal Years 2001-2012*, also identifies trends expected to affect the regional airline industry. These trends include the following:

- Aircraft operations by regional/commuter carriers will increase from 10.8 million to 14.3 million between 2000 and 2012
- Average passenger trip length is expected to increase from 280.4 to 338.8 miles
- Average seats per aircraft departure will increase from 37.5 to 46.0
- Average load factor is expected to increase from 59.0 percent to 62.8 percent

Figure 2.1 is a graphic depiction of the historic and forecast U.S. commercial domestic and international air carrier passenger enplanement data presented in Table 2.1.

Figure 2.1
Historic and Forecast U.S. Enplanements



Source: *FAA Aerospace Forecasts, Fiscal Years 2001 – 2012*

Trends Affecting Commercial Aviation

There has been a significant change in the composition of the commercial airline fleet over the past 10 to 15 years. Many domestic markets were served during the 1970s and 1980s by wide-body aircraft. The Boeing 727, 737, and 747, McDonnell Douglas DC 9 and DC 10, and Lockheed L-1011 aircraft were the mainstays of the domestic commercial airline fleet during this period. Changing economics, age, and competition in aircraft manufacturing, with the arrival of Airbus Industrie, has resulted in a phasing out of the Boeing 727 and older 737s and 747s, McDonnell Douglas (now Boeing) DC 9 and DC 10, and Lockheed L-1011 aircraft. Single aisle narrow-body aircraft including the newer generation Boeing 737s, 757s, and Airbus Industrie A 320 class aircraft now serve the vast majority of domestic markets.

Similarly, the Beech 1900 was the workhorse of the regional airline fleet. However, in the regional airline market, the Beech 1900 is rapidly disappearing from regional airline fleets, being replaced by the new generation of regional jets from Bombardier and Embraer.

The term "regional jet" includes a variety of small jet aircraft that serve the regional airline industry. The types of aircraft considered regional jets typically have a capacity of 30 to 100 seats and can operate from most airfields that currently serve turboprop commuter aircraft. However, these aircraft can and typically do serve much longer distances than turboprop aircraft, often 1,200 miles or more. **Table 2.2** lists some of the typical regional jet aircraft.

Table 2.2
Regional Jet Aircraft

Producer	Aircraft	Capacity
British Aerospace -	BAe 146-100 (Avro RJ70)	86 seats
Avro International	BAe 146-200 (Avro RJ85)	86/89 seats
	BAe 146-300 (Avro RJ100)	100 seats
Bombardier	CRJ-200	50 seats
	CRJ-700	70 seats
	CRJ 900	90 seats
Embraer	EMB 35	37 seats
	EMB 45	50 seats
Fairchild Aerospace	328 Jet	32-34 seats
	428 Jet	44 seats
	728 Jet	70 seats
Fokker Aircraft	F 28-4000	25168 seats
	F-l00	96/101 seats
	F-70	78seats

Source: Wilbur Smith Associates, Inc.

History

Comair, the commuter partner of Delta Air Lines, put the first regional jet into U.S. service in June 1993. Initially, regional jets were accepted somewhat slowly. However, since that initial introduction, the use of regional jets has increased substantially. Regional jets accounted for 90 of the 2,127 (4 percent) commuter aircraft in service in January 1997, operated by seven airlines. By 1998, 11 airlines were operating regional jets. Today, regional jets account for a significant portion of the traffic at most key airline hubs. Regional jet traffic now outnumbers turboprop traffic at some airports, such as Chicago O'Hare. According to *FAA Aerospace Forecasts, Fiscal Years 2001-2012*, regional jet aircraft comprised 11 percent of the total air carrier fleet in 2000.

The growth in regional jet traffic has primarily been limited by the ability of the manufacturers to produce new aircraft. Within the past two to three years, regional jets have steadily increased in size with typical seating for approximately 50 passengers.

The changing fleet mix of regional jets can be seen at many airports over just a one-year period. The continued growth in regional jet use is expected to drive an increase in the average seating configuration of regional airline traffic. The average regional aircraft held 18 passengers in 1986. By 1996, the average seating configuration had increased to 25 seats, and in 1998, regional airline flights averaged 33 seats. The FAA expects an increase to an average of 52 seats by 2015.

Many changes will occur in the airline industry as carriers use regional jets to complement their existing aircraft and serve new routes. Some industry experts feel regional jets will cause a fundamental change in the U.S. airline system of a magnitude similar to the introduction of the jet airliner 40 years ago.

Changing Access to Hubs

The use of regional jets has been rapidly increasing at nearly all U.S. hubs. However, the nature of the change appears to depend on hub traffic conditions. The increase in regional jet use at capacity-constrained hubs has been dramatic while turboprop flights at these airports have decreased substantially. Carriers are rapidly replacing turboprops with regional jets at these airports.

Carriers must be much more selective in the routes they choose to serve with regional jets at capacity-constrained airports. A carrier will choose to serve a large or midsize market with higher load factors before serving a small market with low load factors, in order to maximize profit. The regional jets' operational and economic characteristics are an excellent match for these midsize, high load factor markets. **Tables 2.3** and **2.4** show the trend toward regional jets by the hub carrier at two airports — Chicago's O'Hare and Dallas/Ft. Worth.

Table 2.3
Scheduled Domestic Departures
United and American at Chicago O'Hare

Period	Turboprop	Regional Jet	Large Jet	Total
October 1998	5,441	2,993	21,932	30,368
October 2001	1,178	10,753	17,344	29,275
Percent Change	-78.3%	259.3%	-20.9%	-3.6%

Source: Official Airline Guide, October 1998 & 2001

Table 2.4
Scheduled Domestic Departures
American and Delta at Dallas-Ft. Worth

Period	Turboprop	Regional Jet	Large Jet	Total
October 1998	9,987	58	18,076	28,121
October 2001	6,133	4,977	14,714	25,824
Percent Change	-38.6%	8481.0%	-18.6%	-8.2%

Source: Official Airline Guide, October 1998 & 2001

As shown, regional jet activity is the only facet that has experienced growth at these two airports, while turboprop activity has shown the greatest decline.

While the increasing use of regional jets is a positive trend for many communities, some communities may face negative impacts. Regional jets typically have higher operating costs per seat mile than turboprop aircraft. Airlines require higher load factors to break even with regional jet service than they would with turboprops because of these higher operating costs. The higher operating costs and increased load factor requirements tend to limit the feasibility of regional jet service at the smallest communities. Therefore, these markets, in all likelihood, will only be profitably served with turboprop aircraft. Smaller communities that can only be served profitably with turboprop aircraft may find it increasingly difficult to gain access to capacity-constrained hubs, as carriers continue to replace their turboprop routes with more profitable regional jet routes.

Hubs that do not face severe capacity constraints show a different pattern in traffic growth. Operators at these hubs are not forced to be as selective in choosing the markets they are able to serve from the hub. Salt Lake City is an example. **Table 2.5** shows the change in operations at this airport.

Table 2.5
Scheduled Domestic Departures
Delta at Salt Lake City

Period	Turboprop	Regional Jet	Large Jet	Total
October 1998	1,830	1,024	4,743	7,597
October 2001	1,809	2,562	3,721	8,092
Percent Change	-1.1%	150.2%	-21.5%	6.5%

Source: Official Airline Guide, October 1998 & 2001

As shown, while turboprop activity has declined, turboprops continue to be used at Salt Lake City. It appears that large jet activity has been replaced with regional jet operations at Salt Lake City.

Activity at Phoenix Sky Harbor was examined to see how regional jet operations have changed over the period 1998 to 2001. **Table 2.6** presents a summary of America West's operational fleet activity at Sky Harbor. As shown, turboprop activity has severely declined, with the most significant gains in the regional jet category. This trend follows the general pattern experienced throughout the U.S.

Table 2.6
Scheduled Domestic Departures
America West at Phoenix

Period	Turboprop	Regional Jet	Large Jet	Total
October 1998	1,921	367	5,961	8,249
October 2001	770	896	6,614	8,280
Percent Change	-59.9%	144.1%	11.0%	0.4%

Source: Official Airline Guide, October 1998 & 2001

Increased Customer Satisfaction

Passengers have demonstrated a clear preference for regional jets over turboprops. In addition to the increased comfort offered by newer regional jet aircraft, several high-profile turboprop accidents in 1994 and 1995 have further solidified this preference. One commuter carrier estimated that replacing its turboprop aircraft with regional jets would increase traffic on some of its routes by as much as 20 percent because of this consumer preference.

Passengers also prefer increased frequencies. The use of regional jets provides carriers with a tool to offer increased frequencies on some routes currently served by larger jets, such as 737s. By replacing large jet service with more frequent regional jet service, carriers are able to offer increased frequencies while maintaining profitable load factors. This replacement also allows carriers to continue to service profitably in other low-demand situations, such as beyond normal business hours on busier routes.

Increased Competition

The new point-to-point service and extension of hub reach made possible by regional jets will result in a significant overlap of markets between various carriers. The result – increased competition – will be a benefit to those mid-sized communities that can support regional jet service profitably. In the future, these communities could have many more options when trying to attract increased service, as they will no longer be limited to the local carrier at a single nearby hub.

Regional Jet Summary

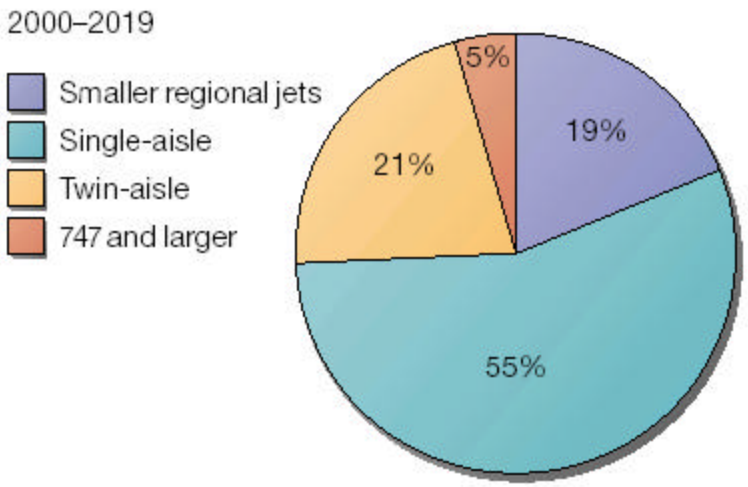
The following points summarize the anticipated impact of regional jets:

- The trend in regional jet replacement of turboprop aircraft will continue into the foreseeable future.
- Regional jet traffic is growing and will continue to grow most rapidly at capacity-constrained hubs.
- Regional jets require larger markets than turboprops to operate profitably. Consequently, the emergence of regional jets does not provide any notable new opportunities for the smallest air service communities.
- Smaller communities that can only be served profitably with turboprops will find it increasingly difficult to gain access to capacity-constrained hubs, as operators at these hubs transition to regional jet routes.
- Turboprop usage remains solid at non-constrained hubs. Smaller communities are most likely to obtain air service through these hubs.
- Medium-sized communities able to support regional jet service are likely to reap significant benefits through increased airline competition, new point-to-point service opportunities, and greater customer satisfaction.
- The acquisition of regional jet equipment may result in the eventual elimination of less profitable turboprop routes.

Large ratios of diversion at all but the most isolated small airports may contribute to further retirement of. 19-seat aircraft in code-sharing fleets. Carriers will cite high relative operating costs for 19-seat airplanes, customer preferences for larger aircraft, and concentration of resources on development of regional jet markets as possible reasons for fleet changes.

The Boeing Commercial Airplane Company develops an annual *Current Market Outlook* for the airline industry that also identifies trends within the aviation industry, particularly as they apply to commercial aviation. **Figure 2.2** is a graphic representation of the future world airline fleet deliveries developed by the Boeing Commercial Airplane Company for their year 2000, *Current Market Outlook*. The Boeing Commercial Airplane Company projects that approximately 55 percent of all future worldwide commercial aircraft deliveries will be single-aisle aircraft, and approximately 19 percent will be comprised of smaller regional jets. The worldwide regional airline fleet included approximately 900 regional jet aircraft in 1999. Boeing projects that number will increase to approximately 4,870 by the year 2019.

Figure 2.2
Composition of Future Commercial Airplane Deliveries



Source: Boeing Commercial Airplane Company, *Current Market Outlook,* 2000

Trends Affecting General Aviation Activity

General aviation aircraft are all aircraft not flown by airlines or the military. General aviation aircraft operate at each MAG airport. The general aviation industry and general aviation activity appear to be revitalized, following a decline that lasted throughout most of the 1980s and into the mid-1990s. Declines in the number of aircraft manufacturers and shipments of single-engine aircraft reflected a sagging general aviation industry prior to 1994. Other indicators such as number of active aircraft, hours flown, and active pilots, all of which are important indicators of the overall health of the general aviation industry, also declined annually during that same period. The result of this downturn was a decline in production of new aircraft from almost 18,000 in 1978 to a low of 928 aircraft in 1994, resulting in the loss of approximately 100,000 jobs in the general aviation industry.

The year 1994 marked a turning point for the general aviation segment. Enactment of the General Aviation Revitalization Act of 1994 established an 18-year Statute of Repose on all general aviation aircraft and components. In layman's terms, the manufacturer's potential for liability for aircraft mishaps was limited to 18 years; previously, there was no time limit for liability. The General Aviation Revitalization Act signaled a significant change in the industry, spurring manufacturers such as Cessna and Piper Aircraft to reenter the single-engine piston-manufacturing sector. In January 1997, Cessna produced its first new single-engine aircraft since 1986. Lancer International, Diamond Aircraft, and Mooney are also producing new piston aircraft domestically. On the downside, the Act has spurred a shift in liability from the manufacturers to airport owners and operators.

The positive effects the Act has had on the general aviation industry since its passage are reflected in recent general aviation activity statistics. Since 1994, activity statistics indicate an increase in general aviation activity at FAA air traffic facilities, an increase in the size of the active general aviation aircraft fleet, and growing shipments and billings of fixed-wing general aviation aircraft. These recent positive trends in the general aviation industry are expected to continue due to a number of factors including the following:

- Construction of new aircraft manufacturing facilities
- Expansion of existing manufacturing facilities
- Increased expenditures on research and development of aircraft and avionics intended to improve flying safety and ease learning

The general aviation industry is also giving increased attention to "learn to fly" educational and promotional activities that should bring new pilots and aircraft mechanics into the industry.

Specific general aviation activity trends identified in the *FAA Aerospace Forecasts* developed by the U.S. Department of Transportation and other national groups are identified in following sections. These anticipated trends are discussed in terms of the number of aircraft shipments and billings, active aircraft and pilots, changes in the active aircraft fleet mix, and business use of general aviation aircraft.

Aircraft Shipments and Billings

The General Aviation Manufacturers Association (GAMA) tracks and reports total shipments and billings of general aviation aircraft. GAMA statistics for 2000 indicate continued strong growth in the sales of general aviation aircraft, both piston and turbojet. During 2000, general aviation aircraft shipments totaled 2,816 aircraft, an increase of approximately of 12.5 percent over 1999. This represents the sixth consecutive year of increased demand for general aviation aircraft. Statistics also indicate that growth in turboprop and jet aircraft shipments are outpacing other sectors of the general aviation aircraft market. A number of factors contribute to this increase in general aviation aircraft shipments including the introduction new aircraft, including three new Cessna Citation business jets, the general strength of the U.S. economy, increases in the number of fractional ownership arrangements, and increases in the number of traditional corporate flight departments among U.S. businesses.

In addition, GAMA tracks total billings of general aviation aircraft, for both domestic and international customers. During 2000, aircraft billings totaled over $8.6 billion, an increase of approximately 9.1 percent over total billings in 1999. Total billings have nearly quadrupled since the early 1990s. Currently, international general aviation shipments and billings represent nearly 21 percent of the U.S. manufactured aircraft.

Table 2.7 presents total general aviation aircraft shipments and billings, on an annual basis, over the time period 1990 through 2000. The statistics presented by GAMA illustrate the strength of the general aviation aircraft manufacturing industry. In addition to the significant increases in total shipments and billings of general aviation aircraft in recent years, it is important to note that the strongest growth appears to be occurring in the jet and turboprop segments of the market. The growth in these segments can be attributed to increased business use of aircraft, and the desire of the business segment of general aviation to operate more sophisticated, safe, efficient, high-performance aircraft. These high-performance aircraft require airport facilities developed to a relatively higher and more demanding standard, a factor that will be considered as system development plans are identified in this analysis.

Table 2.7
Historic General Aviation Aircraft Shipments and Billings

Year	Total General Aviation Aircraft Shipments	Total General Aviation Aircraft Billings ($ millions)
1990	1,144	2,007.5
1991	1,021	1,968.3
1992	941	1,839.6
1993	964	2,143.8
1994	928	2,357.1
1995	1,077	2,841.9
1996	1,130	3,126.5
1997	1,569	4,674.3
1998	2,200	5,873.9
1999	2,504	7,843.6
2000	2,816	8,558.4

Source: General Aviation Manufacturers Association, 2001

Active Pilots

The four major segments of the pilot population – student, private, commercial, and airline transport pilots – each experienced growth in 2000. The total number of active pilots increased to approximately 648,539 pilots in 2000, an increase of almost 13,000 pilots compared to 1999. The student pilot population experienced one of the strongest growth rates, increasing by approximately 7.0 percent. These students represent the future of general aviation and are not only learning to fly for recreational reasons, but also because of career opportunities created by the needs of air carriers, fractional ownership providers, and corporate flight departments. Also worthy of noting is the 2.0 percent growth rate experienced in instrument rated pilots in 2000. Currently, approximately 48.6 percent of the total active pilot population is instrument-rated, another reflection of the increased sophistication of aircraft and pilots.

The FAA has developed forecasts of the future pilot population, by certificate type, based on both historic trends and anticipated future trends. These forecasts project that the total active pilot population in the U.S. will increase from 648,539 in 2000 to 827,177 by 2012, representing an average annual growth rate of approximately 2.0 percent.

Table 2.8 presents the FAA forecasts of the active pilot population, by pilot certificate type, on an annual basis over the forecast period 2000 through 2012.

Table 2.8
Projection of Active Pilots, By Type of Certificate

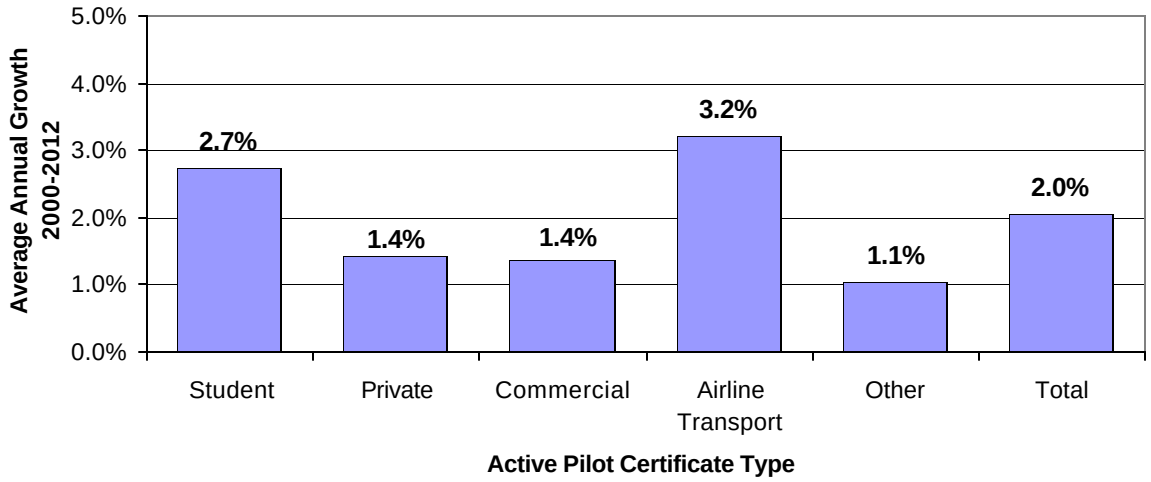
Year	Student	Private	Commercial	Airline Transport	Other 1/	Total
Historical						
1996	94,947	254,002	129,187	127,486	16,639	622,261
1997	96,101	247,604	125,300	130,858	16,479	616,342
1998	97,736	247,226	122,053	134,612	16,671	618,298
1999	97,359	258,749	124,261	137,642	17,461	640,113
2000	104,150	260,700	126,200	139,700	17,789	648,539
Average Annual Growth Rate 1995-2000	***0.6%***	***-0.1%***	***-1.2%***	***2.4%***	***-0.9%***	***0.3%***
Forecast						
2001	107,600	267,400	128,400	144,400	18,104	665,904
2002	110,500	272,000	130,600	149,500	18,348	680,948
2003	113,500	277,500	133,300	154,400	18,563	697,263
2004	116,600	283,700	136,300	159,300	18,717	714,617
2005	119,700	288,000	138,300	164,000	18,882	728,882
2006	122,900	291,400	139,900	169,300	19,076	742,576
2007	126,200	294,600	141,500	174,400	19,265	755,965
2008	129,600	297,600	142,900	180,000	19,465	769,565
2009	133,100	300,600	144,300	186,000	19,664	783,664
2010	136,700	303,600	145,800	192,000	19,829	797,929
2011	140,400	306,600	147,300	198,100	20,003	812,403
2012	144,200	309,600	148,800	204,400	20,177	827,177
Average Annual Growth Rate 2000-2012	***2.7%***	***1.4%***	***1.4%***	***3.2%***	***1.1%***	***2.0%***

Sources: FAA U.S. Civil Aviation Registry; *FAA Aerospace Forecasts, Fiscal Years 2001 – 2012*
Note: 1/ Other pilot category includes pilots with recreational, rotorcraft-only, and glider-only certificates.

The student and airline transport categories of pilots are anticipated to experience the strongest growth over the 12-year forecast period, as shown in Table 2.8, with average annual growth rates of 2.7 percent and 3.2 percent, respectively. The populations of both private and commercial pilots are anticipated to increase at an average annual rate of 1.4 percent over the forecast period.

Figure 2.3 graphically compares the average annual growth rate projected for each pilot type during the study period 2000 to 2012.

Figure 2.3
Projected Growth of Active Pilots, 2000-2012



Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012*
Note: Other category includes aircraft classified by FAA as experimental and other.

The data illustrated in Figure 2.3 show relatively strong growth, ranging from an average annual rate of 1.1 percent in the "other" pilot category to an average annual rate of 3.2 percent in the airline transport pilot category. The strong growth anticipated in the student pilot category is important to note because of the potential impacts that this growing number of pilots may have on all components of general aviation activity in the future. Student pilots, in most cases, will graduate to become active private, commercial, and/or airline transport pilots, which in turn may impact overall active aircraft fleet and general aviation activity statistics.

Aircraft Fleet

The FAA annually tracks the number of active aircraft in the United States. Active aircraft are those aircraft that are currently registered and fly at least one hour during the year. By tracking this information, the FAA is able to identify trends in the total number of active aircraft and the types of aircraft operating in the active fleet. The active general aviation aircraft fleet is anticipated to increase from 221,213 aircraft in 1999 to 245,965 in 2012, representing an average annual growth rate of approximately 0.9 percent, based on FAA estimates. FAA forecasts of the total active aircraft fleet, including each major aircraft type, are summarized in **Table 2.8**.

Table 2.8
Projected Active Aircraft Fleet

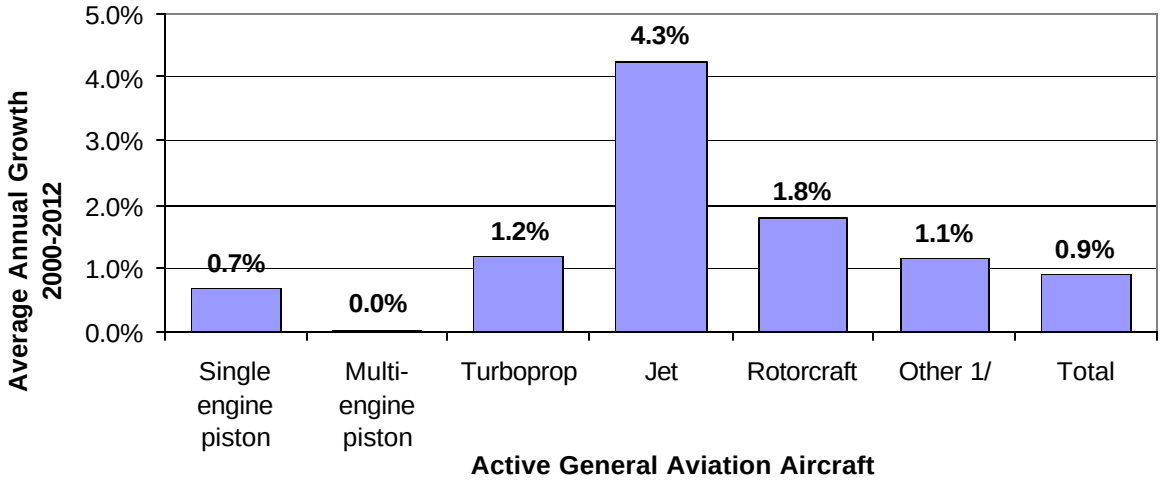
Aircraft Type	2000	2012	Average Annual Growth Rate
Single-engine piston	151,640	164,800	**0.7%**
Multi-engine piston	21,143	21,200	**0.0%**
Turboprop	5,736	6,600	**1.2%**
Jet	7,440	12,280	**4.3%**
Rotorcraft	7,649	9,460	**1.8%**
Other 1/	27,605	31,625	**1.1%**
TOTAL	**221,213**	**245,965**	**0.9%**

Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012*
Note: 1/ Includes aircraft classified by FAA as experimental and other.

The total active aircraft fleet is forecast to experience an average annual growth rate of below 1 percent, as shown in Table 2.8. The relatively strong growth anticipated in active jet aircraft is one of the most important trends identified in these forecasts. This trend illustrates a movement in the general aviation community toward more sophisticated, higher-performing, and more demanding aircraft. This trend will impact the types of activities occurring at general aviation airports and the types of facilities required at those airports.

Figure 2.4 compares the projected average annual growth rate for each type of aircraft in the fleet mix over the period 2000 through 2012. This graphic illustrates the extent to which the growth in jet aircraft is projected to significantly outpace growth in all other components of the aircraft fleet. As shown, turboprop, rotorcraft, and other aircraft are projected to experience an average annual growth rate of over 1 percent per year over the forecast period, while the number of active multi-engine piston aircraft is anticipated to remain stable over the forecast period.

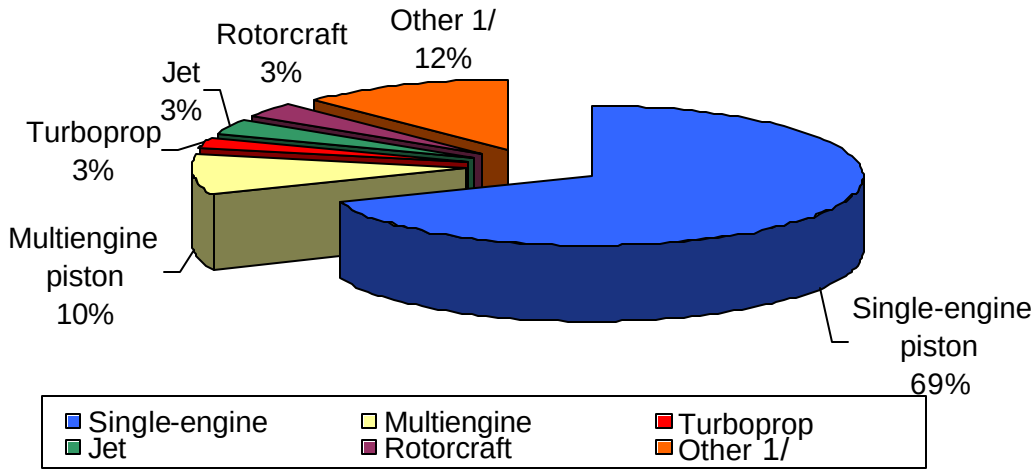
Figure 2.4
Projected Growth of General Aviation Aircraft, 2000-2012



Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012*
Note: 1/ Includes aircraft classified by FAA as experimental and other.

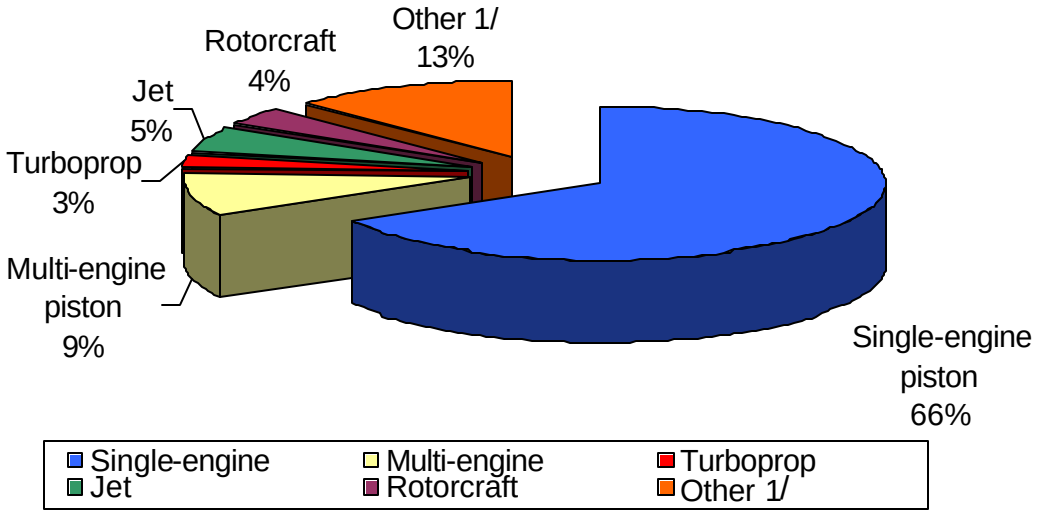
It is also useful to examine the existing and anticipated active aircraft fleet in terms of the percentage of the total fleet each aircraft class represents. **Figure 2.5** presents the existing mix of the 2000 active fleet, while **Figure 2.6** presents the anticipated mix projected for the fleet of 2012.

Figure 2.5
General Aviation Aircraft Fleet Mix, 2000



Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012*
Notes: 1/ Includes both gliders and lighter-than-air aircraft.

Figure 2.6
Projected General Aviation Aircraft Fleet Mix, 2012



Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012*
Notes: 1/ Includes both gliders and lighter-than-air aircraft.

The majority of active aircraft in the current fleet are single-engine piston aircraft, as shown in Figure 2.5. In the year 2012, it is anticipated that the percentage of single-engine piston aircraft will decline from 69 percent to 66 percent of the active fleet, as older aircraft are retired and replaced with more demanding general aviation aircraft, as shown in Figure 2.6.

Forecast data presented by the FAA indicate that each component of the general aviation aircraft fleet mix will either remain steady (multi-engine piston) or grow in terms of total number of active aircraft. Data depicted in the previous figures indicates that jet and other aircraft will be the only components of the general aviation aircraft fleet mix that will see their share of the active fleet grow over the forecast period. Jet aircraft are anticipated to grow from approximately 3 percent of the active general aviation fleet mix in 2000 to approximately 5 percent of the active fleet by 2012, indicating the relative increase in sophistication that is anticipated in the active aircraft fleet and pilot population. The "other" category of aircraft is also forecast to become a larger component of the active fleet, primarily because of growth in experimental aircraft, growing from approximately 12 percent of the fleet to 13 percent of the fleet by 2012.

Current and/or forecast trends affecting general aviation can be summarized as follows:

- Recent and continued increases in the number of annual general aviation aircraft shipments
- Growth in the number of licensed pilots augmented by a relatively strong growth in the number of student pilots
- Moderate growth in the active aircraft fleet and a trend towards the operation of more demanding and more sophisticated jet aircraft as opposed to piston or turboprop aircraft

Business Use of General Aviation Aircraft

Many businesses throughout the U.S. depend on scheduled commercial service airlines, as well as general aviation aircraft, to add to their productivity and efficiency. MAG's airports are essential to the economic progress of the region's citizens and businesses. The region would be severely hampered in its ability to participate in an increasingly global marketplace without these airports. Air transportation facilitates the rapid movement of millions of people and billions of dollars worth of goods to markets around the world. The MAG region must be able to compete in these markets, and there often is no practical alternative to air transportation. Likewise, the growth of a competitive domestic economy depends more and more on our ability to move by air.

The region's airports provide a competitive advantage in a global economy through their provision of convenient air transportation. Today's dynamic economy can present commercial opportunities at any time and in any place. Businesses located in the MAG region must be able to move people and products anywhere in the world safely, quickly, and conveniently to remain competitive and take advantage of those opportunities. Air transportation is an increasingly important means for facilitating commerce and communication among people. Aircraft manufacturers are introducing longer-range jet aircraft that will provide nonstop air service to major cities within the United States and around the world. Increasing numbers of businesses throughout the nation are looking to general aviation aircraft, with their flexibility and efficiency, to support their domestic and international business operations, in addition to scheduled commercial airline services.

The National Business Aircraft Association (NBAA) is an aviation organization representing many of the nation's leading employers who use general aviation as a business tool. NBAA data show that many of the major U.S. corporations use general aviation aircraft, with approximately 70 percent of all *Fortune 500* businesses operating general aviation aircraft. Of the *Fortune 100* companies, 90 operate general aviation

aircraft. A detailed analysis conducted for NBAA in 1998 indicated that, among the *Fortune* 500 companies, there were more than twice as many companies operating general aviation aircraft as non-operators.

Business use of general aviation aircraft ranges from the rental of small, single-engine aircraft up to multiple aircraft corporate fleets supported by dedicated flight crews and mechanics. The use of general aviation aircraft allows employers to efficiently transport personnel and air cargo. Businesses use general aviation aircraft to link multiple office locations and reach existing and potential customers. The use of business aircraft by smaller companies has escalated as various chartering, leasing, time-sharing, interchange agreements, partnerships, and management contracts have emerged. NBAA statistics indicate that the number of flight departments among all the nation's businesses had increased from 6,584 in 1991 to 8,778 in 1999, an increase of approximately 33 percent. Fractional ownership arrangements have also experienced rapid growth. In 1998, NBAA estimated that 1,125 companies used fractional ownership arrangements; by 1999, that number had grown to 1,693 companies, representing growth of over 50 percent in a single year.

Regardless of how the aircraft are owned or what type of aircraft is flown, businesses choose to use general aviation because it provides safe, efficient, flexible, and reliable transportation. Flexibility is the most valued of all the benefits provided to business by general aviation. While there are many reasons that businesses use general aviation in their day-to-day operations, some of the most important factors, according to the businesses themselves, are as follows:

- Flexibility
- Time Savings
- Reliability
- Safety
- Improved Marketing Efficiency
- Facility/Branch Office Control
- Personnel Development Training
- Privacy and Comfort
- Efficiency
- Security

Another benefit of business aircraft use that is becoming increasingly important to both employees and employers is that corporate aircraft minimizes non-business hours away from home. Using business aircraft increases the flexibility of scheduling and provides rapid, safe, and efficient access to meeting locations. These factors allow employees using general aviation aircraft to travel to and from their destination in less time than would be required in a traditional commercial service airline schedule that includes layovers, delays, and other time-consuming events. The positive effect that minimizing non-business time away from home has on employee morale and productivity is impossible to measure, yet growing in importance.

The use of general aviation as a business tool adds to productivity and to the bottom line. According to an NBAA survey of key *Forbes* and *Fortune 500* companies, those businesses who use general aviation aircraft routinely and significantly outperform businesses who do not use general aviation aircraft. Performance indicators such as annual sales, number of employees, value of assets, and annual income are significantly higher for employers using general aviation aircraft.

MAG Aviation Trends

Historic activity level data at MAG airports is presented in the following sections. Airport activity data typically provide a good indication not only of the total amounts of activity occurring at an airport, but also recent increases or declines in activity levels that may have been experienced at MAG facilities. Historical trends are presented for the following components of airport activity:

- Based Aircraft
- Total Aircraft Operations

A number of airports in the MAG region report based aircraft and operations annually to the FAA. The FAA in turn publishes the information and provides projections of activity for each airport in its *Terminal Area Forecasts*. MAG airports included in the *National Plan of Integrated Airport Systems (NPIAS)* report aviation activity to the FAA, which publishes this information in its *Terminal Area Forecasts*.

For the remaining MAG system airports that are not included in the NPIAS, historic based aircraft and operations data were obtained through the inventory process of the Regional Aviation System Plan Update (RASP). Data was collected during on-site airport visits and discussions with airport managers. Each airport however, does not collect this data annually. Comprehensive based aircraft data for MAG Aviation System airports is available for the period from 1996 through the year 2000.

Based Aircraft

The initial effort to quantify based aircraft at MAG system airports relied on the Arizona Division of Aeronautics aircraft registration data. However, after reviewing these data, discussing the information with airport managers, and further investigation, it was determined that quantifying the number of based aircraft from Division of Aeronautics registration data was undesirable, for a number of reasons. Specifically:

1. Some aircraft are not required to be registered by Aeronautics – such as publicly owned aircraft, military aircraft, etc.
2. Some people just do not register their aircraft with Aeronautics or anyone else, intentional or unintentional.
3. Some aircraft are registered in other states, but are actually based at MAG airports – businesses headquartered out of state may base their aircraft at MAG airports, but have them registered in their headquarters state.
4. Some aircraft are based at MAG airports a portion of the year and are not required to be registered with Aeronautics.
5. Some aircraft owners, who relocate from one airport in Arizona to another, do not report they have moved the airplane.
6. Some aircraft are inactive. This could be aircraft that cannot fly, or aircraft that have not flown in the past year.
7. There are other special situations – Goodyear Airport shows roughly 30 jets in the fleet. These include DC-10s that are flown in for refurbishing. While these are not inactive airplanes, they are not based aircraft in the true sense of the term.

Table 2.9 presents based aircraft data for MAG's airports from 1996 to 2000. Based aircraft are those general aviation aircraft permanently stored at an airport in either aircraft storage hangar units or tied down on the aircraft ramp. Based aircraft numbers at airports frequently fluctuate based on a number of factors including pilot preferences and availability of aircraft storage hangar units.

The region experienced a fairly constant rate of based aircraft growth, approximately 3.5 percent per year, during the years 1996 through 1999. From 1999 to 2000, based aircraft grew by almost 9.3 percent.

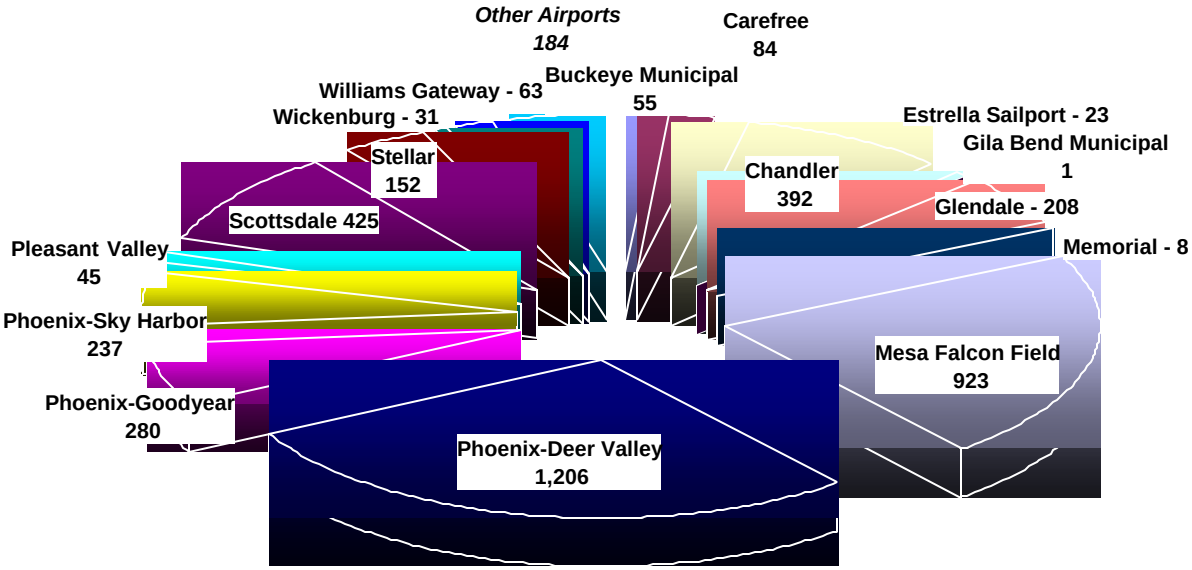
A total of approximately 3,525 aircraft were based at MAG public-use airports in 1996. Over the four-year period, total based aircraft in the Region have grown to 4317 (4,294 in Maricopa County and 23 at Estrella Sailport in Pinal County), an overall increase of 21.8 percent. Total based aircraft have grown at a rate of approximately 5.4 percent, on an average annual basis during this period. **Figure 2.7** depicts the distribution of based aircraft at MAG system airports in the year 2000.

Table 2.9
MAG Historical Airport Based Aircraft, 1996-2000

Facility	YEAR 1996	1997	1998	1999	2000
Buckeye Municipal	43	46	48	50	55
Chandler Municipal	254	300	337	365	392
Estrella Sailport	23	23	23	23	23
Gila Bend Municipal	3	2	3	2	1
Glendale Municipal	188	184	180	197	208
Memorial	12	12	9	10	8
Mesa Falcon Field	800	878	900	894	923
Phoenix-Deer Valley	903	908	913	918	1206
Phoenix-Goodyear	198	198	232	255	280
Phoenix-Sky Harbor International	270	265	270	283	237
Pleasant Valley	25	26	35	41	45
Scottsdale Municipal	403	400	401	424	425
Sky Ranch Carefree	44	54	64	74	84
Stellar	109	120	125	135	152
Wickenburg Municipal	33	32	38	39	31
Williams Gateway	42	41	54	60	63
Public-Use Airports	3,350	3,489	3,632	3,770	4,133
Other Private-Use Airports	*198*	*193*	*184*	*182*	*184*
System Total	**3,548**	**3,682**	**3,816**	**3,952**	**4,317**

Source: Maricopa Association of Governments, Airport Operator Estimates

Figure 2.7
MAG Year 2000 Based Aircraft Distribution



While the FAA does not track based aircraft, they do track active aircraft nationally through a survey titled "General Aviation and Air Taxi Activity Survey." The results of the survey show that the active fleet in the U.S. has increased for five consecutive years, with an overall increase of over 18 percent. This compares to the 21.8 percent increase in based aircraft at MAG airports during the most recent four-year period. The most recent survey period showed an average annual growth rate of 3.3 percent in national active aircraft. The FAA projects that active general aviation aircraft will increase at an average annual rate of 0.9 percent over the 2000 to 2012 period. This rate is significantly lower than the rate at which MAG's total based aircraft have grown in the most recent four-year period, which was 5.4 percent.

Total Aircraft Operations

Historical general aviation operations data for MAG airports for the period 1996-2000 is presented in **Table 2.10**. Airports with FAA air traffic control towers provide reliable operations data. However, it should be noted that at those airports without an FAA air traffic control tower, aircraft operations data represents the best educated guess estimates. These estimates were made by airport managers/operators and, in some instances, through periodic counts, which were extrapolated to obtain annual operations totals.

Table 2.10
General Aviation Aircraft Ope rations in MAG Region, 1996-2000

Facility	1996	1997	1998	1999	2000
Buckeye Municipal	85,000	86,500	88,000	89,000	90,000
Chandler Municipal	156,212	184,139	196,511	221,018	249,811
Estrella Sailport	16,500	16,500	16,500	16,425	16,500
Gila Bend Municipal	849	1,023	1,580	4,500	52,000
Glendale Municipal	119,866	130,255	115,056	133,220	112,570
Memorial	2,300	2,300	2,300	2,300	2,300
Mesa Falcon Field	196,379	209,651	220,969	263,988	274,665
Phoenix - Deer Valley	250,923	266,832	281,753	287,506	370,779
Phoenix – Goodyear	92,405	116,187	103,538	135,960	142,458
Phoenix-Sky Harbor International	77,729	73,303	69,039	69,027	72,007
Pleasant Valley	50,000	50,000	51,000	51,000	52,000
Scottsdale Municipal	183,108	185,100	208,464	230,596	207,032
Sky Ranch Carefree	5,200	5,200	5,400	4,700	4,732
Stellar	50,000	50,000	50,000	40,000	40,880
Wickenburg Municipal	20,886	22,688	19,854	17,349	19,846
Williams Gateway	156,961	186,409	195,802	236,278	158,489
System Airports	**1,464,318**	**1,586,087**	**1,625,766**	**1,802,867**	**1,866,069**

Source: Maricopa Association of Governments, FAA Air Traffic Control Tower records, Airport Operator Estimates

Total general aviation aircraft operations at the 16 airports in the MAG system totaled approximately 1.9 million in 2000. During the period 1996-2000, total aircraft operations in the Region grew from 1.464 million, an overall increase of more than 27 percent during this four-year period. Total general aviation aircraft operations have growth at a rate of approximately 6.2 percent on an average annual basis. Comparatively, aircraft operations recorded by the FAA at U.S. towered airports grew at an average annual rate of 1.7 percent between 1995 and 2000. The FAA projects that general aviation activity at U.S. towered airports will increase at an average annual rate of 2.5 percent over the 2000-2012 period.

It is readily apparent that aircraft operations in the MAG region have grown significantly faster than operations at the vast majority of other airports throughout the United States.

PROJECTIONS OF MAG AVIATION DEMAND

Development of aviation activity projections for MAG's aviation system is a critical step in assessing the need for and phasing of future development requirements. The assumptions and methodologies used to prepare aviation demand projections for the MAG Region are discussed in the following sections:

- Forecast Considerations
- Based Aircraft Projections
- Total Aircraft Operations Projections
- Commercial Air Service Projections

Forecast Considerations

The general approach often used to develop aviation forecasts is to identify historic relationships between regional aviation elements and U.S. aviation activity. For the MAG Regional Aviation System Plan Update, reliable historical data for each airport in the system is not readily available for various activity indicators, as discussed in the previous section. Relatively consistent historic data for the MAG airports is available for a number of years. For the purposes of this analysis, we have focused on the years 1996 through the year 2000.

The accuracy of historic aviation activity data is an issue of the study. Greater confidence can be placed in the number of based aircraft reported by the individual airports as based aircraft figures are more easily counted than aircraft operations. Therefore, a more accurate baseline for based aircraft projections and historic trends analysis is available. Aircraft operations data, on the other hand, represent "best guess" estimates made by airport managers/operators at general aviation airports without an air traffic control tower. These estimates of aircraft operations, in many instances, may be inflated due to the subjective nature of the process. Broad airport activity estimates have not only been the experience for MAG airports. Many other states and regions throughout the U.S. experience a similar overstatement of aviation activity.

The lack of accurate, long-term historic based aircraft and aviation operations data at all MAG airports highlights the importance of the discussion of the national aviation trends in understanding how MAG's aviation activity may be expected to develop in the future. Historic and projected growth rates are presented in this section for both the nation and the MAG region. This comparison of growth rates provides an indication of an appropriate projection methodology for based aircraft and operations activity within the MAG region.

Based Aircraft Trends

Table 2.11 shows a comparison of forecast based aircraft growth rates developed by the FAA in the *FAA Aerospace Forecasts, Fiscal Years 2001-2012* and the *Terminal Area Forecast*. FAA projections presented in these documents were prepared on national, regional, and state levels, based largely on historic growth trends and industry dynamics. Each projection is discussed briefly below.

Table 2.11
Comparison of Based Aircraft Growth Rates

Growth Rate Source	Historic Growth			Projected Growth		
Area Included In Forecast	Base Year	Out Year	AAG	Base Year	Out Year	AAG
FAA Aerospace Forecasts						
U.S.- Active GA Aircraft	1995	1999	3.93%	2000	2012	0.89%
FAA Terminal Area Forecasts						
U.S.	1989	1999	0.79%	1999	2015	0.59%
Western Pacific Region	1989	1999	-0.43%	1999	2015	0.74%
MAG Airports	1989	1999	1.24%	1999	2015	1.20%

Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012,* FAA *Terminal Area Forecast,* and WSA analysis

FAA Aerospace Forecasts, Fiscal Years 2001-2012

FAA Aerospace Forecasts, Fiscal Years 2001-2012 provides projections of the total U.S. active general aviation fleet. For any given year, the U.S. fleet is defined as the sum of new production flowing into the fleet, the fleet size carried over from the previous year, and the attrition of existing aircraft during the current year. A detailed summary of the FAA's projected aircraft fleet and fleet mix was previously presented. An estimated 219,000 active general aviation aircraft were based at U.S. airports in 1999. Between 1995 and 1999, active general aviation aircraft increased 3.93 percent per year on average. This historic growth was significantly less than the growth in based aircraft at all MAG airports between 1996 and 2000. The national growth in aircraft fleet is expected to slow over the 12-year forecast period, increasing at an average annual growth rate of 0.89 percent per year, reaching 246,000 active general aviation aircraft in 2012.

FAA Terminal Area Forecasts

Terminal Area Forecasts (TAF) are the official projections of aviation activity at individual FAA facilities and all airports included within the *National Plan of Integrated Airport Systems (NPIAS)* including FAA towered airports, federally contracted towered airports, nonfederal towered airports, and non-towered airports. Many of the smaller general aviation airports and privately owned public-use airports do not submit their aviation activity to the FAA. Within MAG, 12 of the 16 airports (75 percent) are included in the NPIAS, while 8 of the 16 system airports (50 percent) have FAA operated or contract air traffic control towers. Between 1989 and 1999, based aircraft at all U.S. airports reporting to the TAF grew at an average annual growth rate of 0.79 percent. Based aircraft at airports in the FAA-defined Western Pacific Region actually decreased during this same period at an average annual rate of -0.43 percent per year. The Western Pacific Region includes airports in the states of Arizona, California, Nevada, and Hawaii. MAG airports reporting to the TAF during the period 1989-1999 experienced an historic average annual rate of growth of 1.24 percent.

The FAA TAF projections of based aircraft are updated annually. Between 1999 and 2015, the FAA projected a broad range of rates of growth for based aircraft at all airports in the U.S., FAA's Western Pacific Region, and MAG, growing at an average annual rate of 0.59 percent, 0.74 percent, and 1.20 percent, respectively. Again, it is important to note that only 75 percent, or 12 of the 16 airports in the system, were included in the latest TAF.

Operations Trends

A comparison of historic and projected aircraft operations growth rates are presented in **Table 2.12**. The FAA has prepared national operations projections in conjunction with the *FAA Aerospace Forecasts*, as well as annual airport projections as part of the *Terminal Area Forecasts*. These projections provide a comparison for the RASP operational forecasts.

Table 2.12
Comparison of Operations Growth Rates

Growth Rate Source Area Included In Forecast	Historic Growth			Projected Growth		
	Base Year	Out Year	AAG	Base Year	Out Year	AAG
FAA Aerospace Forecasts						
U.S. Towered Airports (All Ops)	1995	2000	1.9%	2000	2012	2.42%
U.S. Towered Airports (GA Ops Only)	1995	2000	1.8%	2000	2012	2.19%
U.S.- GA Hours Flown	1995	1999	4.5%	2000	2012	2.20%
FAA Terminal Area Forecasts						
U.S.- Total Ops	1989	1999	0.5%	1999	2015	1.14%
U.S.- GA only	1989	1999	0.1%	1999	2015	1.00%
Western Pacific	1989	1999	0.0%	1999	2015	1.49%
Western Pacific-GA only	1989	1999	-0.3%	1999	2015	1.25%
MAG Airports- Total Ops	1989	1999	3.0%	1999	2015	2.50%
MAG Airports-GA only	1989	1999	2.8%	1999	2015	2.38%
FAA-Tower Counts						
MAG Towered Airports-Total Ops	1995	2000	5.8%	1999	2015	2.57%
MAG Towered Airports-GA Ops only	1995	2000	5.7%	1999	2015	0.24%
MAG Towered (excl. PHX)-Total	1995	2000	6.8%	1999	2015	0.21%

Source: *FAA Aerospace Forecasts, Fiscal Years 2001-2012,* FAA *Terminal Area Forecast,* and WSA analysis

FAA Aerospace Forecasts, Fiscal Years 2001-2012

The FAA projected aviation activity at combined FAA and contract towered airports only, as part of the *FAA Aerospace Forecasts, Fiscal Years 2001-2012*. Between 1995 and 2000, total operations at towered airports grew at an average annual rate of 1.9 percent, which was slightly higher than the growth experienced in general aviation operations, up 1.8 percent per year on average. Total operations are projected to experience strong growth between 2000 and 2012, up 2.42 percent per year on average over the period. The FAA has projected general aviation operations to experience a slightly lower average annual growth rate of 2.19 percent.

The FAA also projects the number of hours flown by general aviation aircraft, another indicator of general aviation activity. Based on results from the 1999 General Aviation and Air Taxi Activity Survey, hours flown grew 4.5 percent on average annually between 1995 and 1999. While active aircraft is projected to grow just 0.9 percent annually between 2000 and 2012, general aviation hours flown are projected to increase 2.2 percent annually over the 12-year period.

FAA Terminal Area Forecasts (TAF)

The FAA also develops annual forecasts of operations by airport as part of the *Terminal Area Forecasts.* The TAF forecasts, as noted previously, are developed for those airports included in the NPIAS. While both total activity and general aviation operations experienced little growth at all U.S. airports as reported in the FAA TAF, operations at airports in FAA's Western Pacific Region showed no growth between 1989 and 1999.

Total aircraft operations at the MAG airports that reported to the FAA TAF (50 percent) increased at an average annual rate of 3.0 percent between 1989 and 1999. General aviation operation at these airports grew 2.8 percent annually over this same 10-year period. The FAA TAF projects total operations at MAG airports to grow annually at 2.50 percent between 1999 and 2015. General aviation operations are projected to increase at 2.38 percent per year, on average.

FAA Tower Counts

Eight airports within the MAG region have FAA-operated or contracted air traffic control towers, including seven general aviation airports (Chandler, Glendale, Mesa – Falcon Field, Phoenix Deer Valley, Phoenix Goodyear, Scottsdale Municipal, and Williams Gateway) and Phoenix Sky Harbor International. Between 1995 and 2000, these airports experienced substantial growth in total aviation operations equivalent to 5.8 percent per year, on average. General aviation operations at these airports increased at an average annual rate of 5.7 percent per year. Excluding Phoenix Sky Harbor International, the MAG Region's largest airport, total operations at MAG towered airports increased 6.8 percent per year, on average, between 1995 and 2000.

Based Aircraft Projections

A total of seven methodologies were used to project based aircraft for the MAG airport system to ensure a reasonable forecast. These methodologies include both "bottom-up" and "top-down" approaches. The first methodology, which is a "bottom-up" approach, used the historic trend of based aircraft identified at each airport to forecast future based aircraft. The six additional methodologies projected based aircraft using a "top-down" approach, which projected based aircraft for the entire MAG airport system relative to a number of factors including a linear trend of historic based aircraft, the county's historic market share of the U.S. aircraft fleet, and various socioeconomic parameters for Maricopa County. **Table 2.13** presents the based aircraft projections developed using the respective methodologies. The future based aircraft projections derived by applying the FAA TAF growth rate, the FAA Aerospace Forecast 2001-2012, and the growth rates presented in the various airport master plans are shown on Table 2.13 for comparison purposes. Each of the specific methodologies used to project based aircraft and the preferred based aircraft projections are discussed in the following sections. **Figure 2.9** presents a graphic comparison of these data.

<u>Bottom Up Methodologies</u>

Trendline Projection of Individual MAG Airports Historic Based Aircraft

The first methodology was a "bottom-up" approach using the historic linear trend of the recorded numbers of based aircraft at each airport. Each of the system airports showed varying degrees of growth in based aircraft, with the exception of Phoenix Sky Harbor, which experienced a decline, as reflected in Table 2.9. Overall, system-wide based aircraft increased by a total of 769 aircraft over the period 1996 to 2000.

A trend line projection of based aircraft was developed using historic based aircraft at each airport. This was then projected through the year 2025 for each airport. These projections were then summed for each five-year interval during the forecast period through the year 2025.

Based aircraft are projected to increase from 4,133 in 2000 to 7,288 in the year 2025, an average annual growth rate of 2.3 percent, as shown in Table 2.13. This growth rate is significantly lower than the 4.2 percent per year average annual growth rate experienced within the MAG region between 1996 and 2000. However, this growth rate is higher than the FAA's projected 0.74 percent average annual growth rate in the Western Pacific Region.

Master Plan

A further assessment of based aircraft growth within the MAG airport system was developed using the growth rates identified in the various Airport Master Plans prepared for system airports over the past years. The respective Airport Master Plans were reviewed to determine the average annual growth rates for based aircraft over the respective planning periods, which ranged from 21 to 25 years in duration. (It should be noted that the majority of these documents were developed in the mid-1990s and some were developed in the late 1980s.) The average annual growth rate identified for the planning period relative to each airport master plan was then applied to the actual year 2000 based aircraft totals at the respective airports and extrapolated through the year 2025. The individual airport totals were then summed to arrive at a MAG system total. It should be further noted that a number of airports did not have airport master plans. For those airports, the year 2000 based aircraft totals were held constant throughout the planning period.

This check resulted in a projection of 6,673 based aircraft at MAG system airports in the year 2025, which represents an average annual growth rate of 1.9 percent.

Top Down Methodologies

Trendline Projection of Total MAG System Historic Based Aircraft

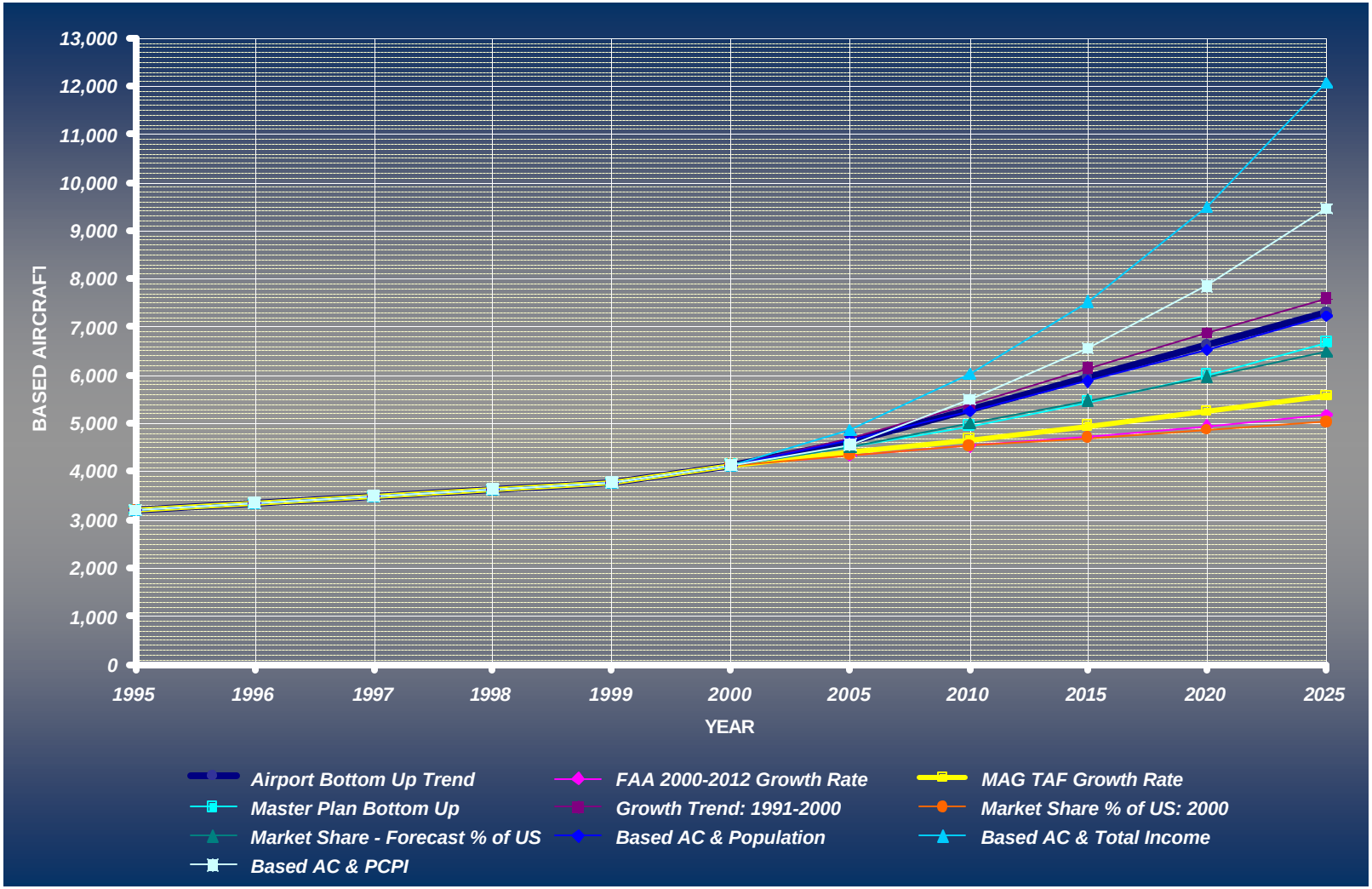
This methodology established the historic linear trend of based aircraft within the MAG airport system. A trendline projection of total based aircraft within the MAG airport system was then developed through the year 2025, using this historic linear relationship. Table 2.13 presents the regional based aircraft projections developed using this methodology. The system-wide trendline projection of based aircraft show total based aircraft increasing from 4,133 in the year 2000 to 7,597 in the year 2025, an average annual growth rate of 2.5 percent. This growth rate, as with the "bottom-up" growth rate discussed previously, is significantly lower than the 4.2 percent per year average annual growth rate experienced within the MAG region during the period 1996 through 2000. However, this growth rate is also higher than the FAA's projected 0.74 percent average annual growth rate in the Western Pacific Region.

Table 2.13
Historic and Forecast MAG Based Aircraft

		Bottom Up			Top Down						
Year	Historical	Airport Trendline	Master Plan	Growth Trend: 1991-2000	Market Share % of US - 2000	Market Share Forecast % of US	Based AC & Population	Based AC & Total Income	Based AC & PCPI	FAA Aerospace Forecast Growth	MAG TAF Growth Rate
Historical											
1991	2,852										
1992	2,837										
1993	2,825										
1994	2,891										
1995	3,185										
1996	3,350										
1997	3,489										
1998	3,632										
1999	3,770										
2000	4,133										
Forecast											
2005		4,615	4,513	4,681	4,344	4,520	4,664	4,870	4,560	4,322	4,387
2010		5,283	4,945	5,410	4,527	4,996	5,248	6,034	5,485	4,520	4,657
2015		5,952	5,439	6,139	4,692	5,472	5,873	7,528	6,554	4,728	4,943
2020		6,620	6,010	6,868	4,857	5,970	6,533	9,490	7,851	4,944	5,247
2025		7,288	6,673	7,597	5,028	6,497	7,220	12,073	9,444	5,171	5,569
AAG Rate		2.3%	1.9%	2.5%	0.8%	1.8%	2.3%	4.4%	3.4%	0.9%	1.2%

Source: Maricopa Association of Governments and Wilbur Smith Associates

Figure 2.9
Historic and Forecast MAG Based Aircraft



Projections Based on MAG % Market Share of U.S. Fleet - 2000

This methodology established the MAG airport systems historic market share of the U.S. fleet for the year 2000. This market share was held constant throughout the FAA's year 2012 forecast period. Projections of the MAG system's based aircraft totals were then calculated assuming a constant share of the projected U.S. fleet. Beyond the FAA's year 2012 forecast horizon, the year 2012 U.S. aircraft fleet was extrapolated through the year 2025 using the same average annual growth rate used by the FAA for the period 2001-2012. The system-wide based aircraft projections developed using this methodology, shown on Table 2.13, show total based aircraft increasing from 4,133 in the year 2000 to 5,028 in the year 2025, an average annual growth rate of 0.8 percent. This growth rate, as with the methodologies discussed previously, is significantly lower than the 4.2 percent per year average annual growth rate experienced within the MAG region during the 1996-2000 period. However, this growth rate is comparable to the FAA's projected 0.74 percent average annual growth rate in the Western Pacific Region.

Projections Based on Forecast % Market Share of U.S. Fleet

This methodology is similar to the previously discussed methodology. However, rather than holding the MAG system's share of the U.S. fleet constant throughout the year 2025, a trendline projection of the historic MAG market share of the U.S. fleet was developed and projected throughout the planning period. This approach recognizes the growing percentage of the MAG region's aircraft fleet relative to the U.S. fleet since 1991. The MAG system's portion of the U.S. fleet was then determined based on the projected trendline projection of its historic share of the fleet. The system-wide based aircraft projections show total based aircraft increasing from 4,133 in the year 2000 to 6,497 in the year 2025, an average annual growth rate of 1.8 percent. While significantly lower than the 4.2 percent per year average annual growth rate experienced within the MAG region during the 1996-2000 period, it is higher than the FAA's projected 0.74 percent average annual growth rate in the Western Pacific Region.

Projections Based on Population

Table 2.14 presents historical population for the MAG region for the years 1990 through 1999, while **Figure 2.10** is a graphic representation of the historical population listed in this table. **Table 2.15** presents the projected population of Arizona and the MAG region for the years 2000 through 2025. The based aircraft methodology presented in this section of the document correlates based aircraft to historic and projected study area population through a linear regression analysis. The population projections presented in this section are based on the projections developed by the Arizona Department of Economic Security (DES).

Table 2.14
Historical Population Comparison –
U.S., Arizona, and MAG 1990-1999

Year	Jurisdiction			
	United States	Arizona	Phoenix-Mesa, AZ (MSA)	Maricopa County
1990	249,464,396	3,679,056	2,245,805	2,129,352
1991	252,153,092	3,762,394	2,302,011	2,183,182
1992	255,029,699	3,867,333	2,366,971	2,244,827
1993	257,782,608	3,993,390	2,444,670	2,318,774
1994	260,327,021	4,147,561	2,549,507	2,419,394
1995	262,803,276	4,306,908	2,661,324	2,526,113
1996	265,228,572	4,432,308	2,753,549	2,614,093
1997	267,783,607	4,552,207	2,841,395	2,698,459
1998	270,248,003	4,667,277	2,930,726	2,783,779
1999	272,690,813	4,778,332	3,013,696	2,861,395

Source: DES Population Statistics Unit
1/ Census Bureau midyear population estimates. Estimates for 1990-99 reflect county population estimates available as of March 2000.

Linear regression analysis establishes the correlation between two variables, one dependent and the second independent. This methodology determined the relationship between based aircraft (the dependent variable) and Maricopa County population (the independent variable). The historical relationship between the study area population and the total number of historic based aircraft within the MAG airport system was first established. Projections of future based aircraft were then developed using the population projections through the year 2025, based on the linear regression analysis.

The correlation coefficient, expressed as r^2, represents the calculated relationship between the dependent variable and independent variable. Correlation coefficients, r^2 values, range between +1 and –1.0. An r^2 of +1.0 indicates that there is a direct relationship between the dependent and independent variables, i.e., there is a very direct and close relationship between the two variables and the independent represents a strong predictor of the independent variable. An r^2 of -1.0 indicates that there is essentially no relationship between the dependent and independent variables, i.e., and in all likelihood increasing values of the independent variable are a strong predictor of decreasing values of the independent variable.

The correlation between MAG based aircraft and population resulted in an r^2 value of 0.97. This r^2 value would indicate that there is a very strong correlation between MAG population and based aircraft. This methodology results in the number of based aircraft increasing from 4,133 in 2000 to 7,220 in the year 2025, representing an average annual growth rate of 2.3 percent, as shown on Table 2.13. This growth rate is significantly lower than the 4.2 percent per year average annual growth rate experienced between 1996 and 2000, and higher than the FAA's projected 0.74 percent average annual growth rate in the Western Pacific Region.

Figure 2.10
Graphic Population Comparison –
Arizona and MAG 1990-1999

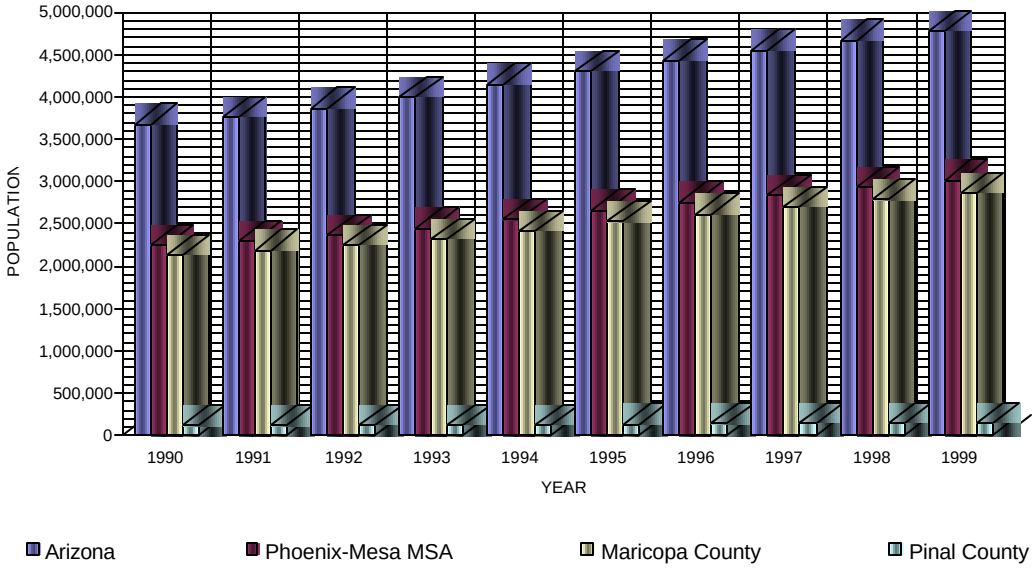


Table 2.15
Population Projections – Arizona and MAG 2000-2025

Year	Arizona	Maricopa County	Year	Arizona	Maricopa County
2000	5,130,632	3,072,149			
2001	5,080,775	3,029,150	2016	6,866,913	4,182,766
2002	5,199,151	3,104,077	2017	6,989,981	4,264,715
2003	5,317,455	3,179,155	2018	7,113,854	4,347,651
2004	5,435,714	3,254,363	2019	7,238,432	4,431,453
2005	5,553,849	3,329,561	2020	7,363,604	4,516,090
2006	5,672,449	3,405,237	2021	7,489,187	4,601,410
2007	5,790,568	3,480,881	2022	7,614,898	4,687,300
2008	5,908,602	3,556,813	2023	7,740,891	4,773,884
2009	6,026,727	3,633,006	2024	7,866,951	4,860,929
2010	6,145,108	3,709,566	2025	7,993,039	4,948,423
2011	6,263,911	3,786,659			
2012	6,383,147	3,864,262			
2013	6,502,976	3,942,612			
2014	6,623,465	4,021,755			
2015	6,744,754	4,101,784			

Source: 2000 data – U.S. Census, 2001-2025 data – Arizona Department of Economic Security, Population Statistics Unit Feb-97

Projections Based on Total Income

This methodology established the historic relationship between total income and historic based aircraft in the MAG region. A linear regression of this relationship was developed for the period 1990-1999, which was then applied to the forecast total income for Maricopa County through the year 2025. **Table 2.16** presents historic total income for the MAG region for the years 1990 through 1999. In addition, forecast total income for Maricopa County is presented through the year 2025. The number of based aircraft derived using this methodology resulted in projected growth from the 4,133 based aircraft at the system airports in the year 2000 to more than 12,000 based aircraft in the year 2025. This methodology resulted in a correlation coefficient (r^2 value) of 0.95, indicating a very strong relationship between total income and based aircraft. The average annual growth rate derived using this methodology was 4.4 percent throughout the planning period. This rate of growth is higher than the growth rate experienced at the system airports since 1996 and dramatically higher than the growth rates for any of the other methodologies.

Table 2.16
Arizona and MAG Total Income: 1990-2025

Year	Arizona	Jurisdiction Phoenix-Mesa, AZ (MSA)	Maricopa County
1990	$63,319,165,000	$42,363,841,000	$40,939,514,000
1991	$66,077,264,000	$43,849,370,000	$42,287,800,000
1992	$70,119,915,000	$46,434,370,000	$44,791,129,000
1993	$74,900,034,000	$49,453,430,000	$47,661,114,000
1994	$82,014,177,000	$54,555,276,000	$52,652,788,000
1995	$88,870,496,000	$59,755,732,000	$57,742,963,000
1996	$95,787,251,000	$64,964,253,000	$62,822,350,000
1997	$103,701,532,000	$71,070,781,000	$68,823,173,000
1998	$112,633,460,000	$77,605,603,000	$75,239,872,000
1999	$120,287,327,000	$83,227,764,000	$80,705,276,000
2000	-	-	$83,608,180,000
2005	-	-	$114,597,740,000
2010	-	-	$153,780,890,000
2015	-	-	$204,064,720,000
2020	-	-	$270,096,500,000
2025	-	-	$357,040,510,000

Source: Regional Economic Information System, Bureau of Economic Analysis & Arizona State University

Projections Based on Per Capita Personal Income

This methodology is similar to both the population and total income methodologies explained previously. However, the projected growth is based on historic and projected per capita personal income. **Table 2.17** presents historic per capita personal income for the U.S., Arizona, and MAG region for the years 1990 through 1999. In addition, forecast per capita personal income for Maricopa County is presented through the year 2025. Dividing the forecast total income listed in Table 2.16 by the projected population within Maricopa County through the year 2025 derived the forecast per capita personal income.

Table 2.17
U.S., Arizona, and MAG: Per Capita Personal Income 1990-1999 (dollars)

Year	Jurisdiction United States	Arizona	Phoenix-Mesa, AZ (MSA)	Maricopa County
1990	$19,584	$17,211	$18,864	$19,226
1991	$20,089	$17,563	$19,048	$19,370
1992	$21,082	$18,131	$19,618	$19,953
1993	$21,718	$18,756	$20,229	$20,554
1994	$22,581	$19,774	$21,398	$21,763
1995	$23,562	$20,634	$22,453	$22,858
1996	$24,651	$21,611	$23,593	$24,032
1997	$25,874	$22,780	$25,013	$25,505
1998	$27,321	$24,133	$26,480	$27,028
1999	$28,546	$25,173	$27,617	$28,205
2000	-	-	-	$27,000
2005	-	-	-	$33,084
2010	-	-	-	$40,012
2015	-	-	-	$48,019
2020	-	-	-	$57,726
2025	-	-	-	$69,657

Source: Regional Economic Information System, Bureau of Economic Analysis
1/ Per capita personal income was computed using Census Bureau midyear population estimates. Estimates for 1990-99 reflect county population estimates available as of March 2000.

Comparison With TAF and FAA Aerospace Forecasts

The based aircraft projections developed for this study, and as discussed in the preceding narrative, reflect the most recent aviation activity and socioeconomic data available. The FAA develops two aviation activity forecasts, the most recent of which are presented in the *FAA Aerospace Forecasts, 2001-2012* and the *FAA Terminal Area Forecast* (TAF), which provides activity projections for the period 1999-2015.

Each of these documents represents "top-down" approaches to aviation activity forecasting and includes forecasting parameters focused on the national level. Unfortunately, these documents do not incorporate the most current data available that were used to develop the based aircraft projections presented in this report. The *FAA Aerospace Forecasts, 2001-2012* are based on data up to and including the year 2000, with year 2000 numbers reflecting *estimates* of aviation activity. However, the socioeconomic parameters used in the development of these forecasts are not based on year 2000 Census data, as they were developed prior to the availability of the year 2000 Census reports. The TAF incorporates actual data up to and including the year 1999. However, the TAF forecasts, in addition to not reflecting the year 2000 Census data, also do not reflect the most recently recorded actual activity levels at airports throughout the country.

The *FAA Aerospace Forecasts* are based on an "across the board" average annual growth rate of 0.9 percent for the period 2000-2012, which represents a projection of 5,171 total based aircraft at MAG system airports in the year 2025. This growth rate is significantly lower than most recent actual average annual growth rate of 4.2 percent experienced within the MAG airport system. Beyond that, this growth rate is also below the FAA's TAF growth rate for MAG airports, which represented an average annual

growth rate of 1.2 percent and translates into 5,569 total based aircraft at MAG system airports in the year 2025.

Both the *FAA Aerospace Forecasts* and the TAF projections do not incorporate 2000 Census data, relying on estimates of socioeconomic parameters. In addition, the TAF does not have the benefit of the most recent actual activity data for the MAG system airports. This is particularly important in view of the ongoing rapid growth in aviation activity within the MAG airport system.

Preferred Based Aircraft Projection

A review of the various methodologies used to project based aircraft revealed a broad range of possible based aircraft totals for the MAG system. These ranged from a high of more than 12,000 total based aircraft to just over 5,000. However, this review also revealed that two of these methodologies resulted in almost identical based aircraft projections for MAG system airports over the course of the planning period. The 'bottom-up" airport trendline projection and the "top-down" linear regression population projection resulted in total based aircraft projections of 7,288 and 7,220 based aircraft, respectively, in the year 2025.

The "bottom-up" trendline projection of based aircraft has been selected as the preferred projection since this methodology more closely reflects actual historical conditions at each system airport. This results in a 2025 based aircraft projection of 7,228 aircraft at MAG public-use airports. The fact that the methodology based on the correlation between Maricopa County population and based aircraft is almost identical to the preferred methodology serves to reinforce this choice.

To derive a total based aircraft projection for the MAG region, including the other private-use airports, the percentage of based aircraft at the other airports (approximately 4.2 percent) was assumed to be constant through 2025. Using this methodology, based aircraft at the public and private-use airports in MAG are projected to increase from 4.317 in 2000 to 7.612 in 2025. **Table 2.18** lists the historic and projected trendline distribution of MAG based aircraft by airport through the year 2025.

Table 2.18
MAG Historic and Preferred Based Aircraft Projections

	Historical										Projected					
Facility	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**AAG %**
Buckeye Municipal	50	52	40	70	38	43	46	48	50	55	70	85	101	116	132	
Chandler Municipal	238	241	244	247	183	254	300	337	365	392	450	539	629	718	807	
Estrella Sailport	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
Gila Bend Municipal	9	7	6	4	3	3	2	3	2	1	6	7	8	9	10	
Glendale Municipal	167	160	143	178	184	188	184	180	197	208	237	269	300	332	364	
Memorial	27	27	27	27	27	12	12	9	10	8	12	14	15	17	19	
Mesa Falcon Field	580	573	566	559	795	800	878	900	894	923	1062	1193	1324	1455	1586	
Phoenix-Deer Valley	778	796	805	803	898	903	908	913	918	1206	1267	1471	1675	1879	2084	
Phoenix-Goodyear	142	144	151	153	145	198	198	232	255	280	340	419	498	578	657	
Phoenix-Sky Harbor International	270	238	218	224	283	270	265	270	283	237	231	207	183	159	135	
Pleasant Valley	17	19	20	21	23	25	26	35	41	45	56	71	86	101	116	
Scottsdale Municipal	405	403	420	393	400	403	400	401	424	425	427	439	450	461	473	
Sky Ranch Carefree	25	30	33	52	35	44	54	64	74	84	108	138	169	199	230	
Stellar	94	96	98	100	101	109	120	125	135	152	170	201	231	261	291	
Wickenburg Municipal	27	28	31	32	24	33	32	38	39	31	41	45	50	55	60	
Williams Gateway	--	--	--	5	23	42	41	54	60	63	115	162	208	255	301	
MAG Public-Use Airports	**2,852**	**2,837**	**2,825**	**2,891**	**3,185**	**3,350**	**3,489**	**3,632**	**3,770**	**4,133**	**4,615**	**5,283**	**5,950**	**6,618**	**7,288**	**2.3%**
Other Private-Use Airports	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*198*	*193*	*184*	*182*	*184*	*205*	*235*	*265*	*295*	*324*	
System Total	**2,852**	**2,837**	**2,825**	**2,891**	**3,185**	**3,548**	**3,682**	**3,816**	**3,952**	**4,317**	**4,820**	**5,518**	**6,215**	**6,913**	**7,612**	2.3%

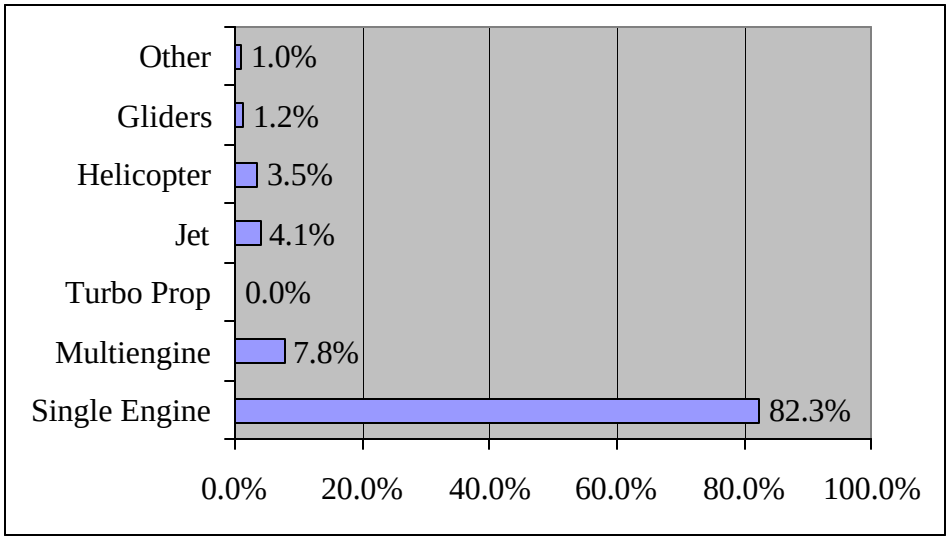
Source: Maricopa Association of Governments, Airport Operator Estimates, Wilbur Smith Associates

Aircraft Fleet Mix

An airport's based aircraft fleet mix is one indication of its operational role and its facility needs. In projecting the based aircraft fleet mix for the MAG airport system, consideration was given to the continually changing national active general aviation aircraft fleet and the existing fleet mix at each airport. As previously discussed, the FAA anticipates strong growth in active jet aircraft. This trend illustrates a movement in the general aviation community toward more sophisticated, higher-performing, and more demanding aircraft. This trend will impact the types of activities occurring at general aviation airports and the types of facilities required at those airports. The FAA projects that growth in jet aircraft is projected to significantly outpace growth in all other components of the aircraft fleet. Turboprop, rotorcraft, and other aircraft are projected to experience an average annual growth rate of over 1 percent per year over the forecast period, while the number of active multi-engine piston aircraft is anticipated to remain stable over the forecast period.

To project based aircraft by aircraft types for each airport, the existing aircraft fleet at MAG airports was first examined. In 2000, single engine aircraft accounted for over 82 percent of the based aircraft fleet at the MAG airports, as depicted in **Figure 2.11**.

Figure 2.11
MAG Based Aircraft Fleet Mix - 2000



Source: Maricopa Association of Governments, Airport Operator Estimates

For this analysis, based aircraft fleet mix was projected for each airport for 2025, the out year of the forecast period of the MAG RASP. The based aircraft fleet mix was first projected for the region, and then applied back to the airports based on each airport's existing based aircraft fleet mix. **Table 2.19** presents the 2000 based aircraft fleet mix for each of the MAG airports. **Figure 2.12** and **Table 2.20** present the 2025 based aircraft fleet mix.

Table 2.19
MAG Based Aircraft Fleet Mix - 2000

Facility	Single Engine	Multi Engine	Turbo Prop	Jet	Helicopter	Gliders	Other	Total Based Aircraft
Buckeye Municipal	42	0	0	0	6	0	7	55
Chandler Municipal	354	23	0	0	14	1	0	392
Estrella Sailport	3	0	0	0	0	20	0	23
Gila Bend Municipal	1	0	0	0	0	0	0	1
Glendale Municipal Airport	186	13	0	0	4	1	4	208
Memorial	5	3	0	0	0	0	0	8
Mesa Falcon Field	832	30	0	5	56	0	0	923
Phoenix-Deer Valley	1,065	88	0	28	23	2	0	1,206
Phoenix-Goodyear	252	21	0	1	2	4	0	280
Phoenix-Sky Harbor International	108	49	0	55	15	0	10	237
Pleasant Valley	10	0	0	0	0	20	15	45
Scottsdale Municipal	267	68	0	72	16	1	1	425
Sky Ranch Carefree	70	10	0	0	0	1	4	84
Stellar	133	7	2	3	3	0	0	152
Wickenburg Municipal	27	1	0	0	2	1	0	31
Williams Gateway	48	9	0	4	2	0	0	63
System-wide	**3,403**	**322**	**2**	**168**	**143**	**51**	**41**	**4,133**
	82.3%	7.8%	0.0%	4.1%	3.5%	1.2%	1.0%	

Source: Maricopa Association of Governments, Airport Operator Estimates

Figure 2.12
MAG Based Aircraft Fleet Mix - 2025

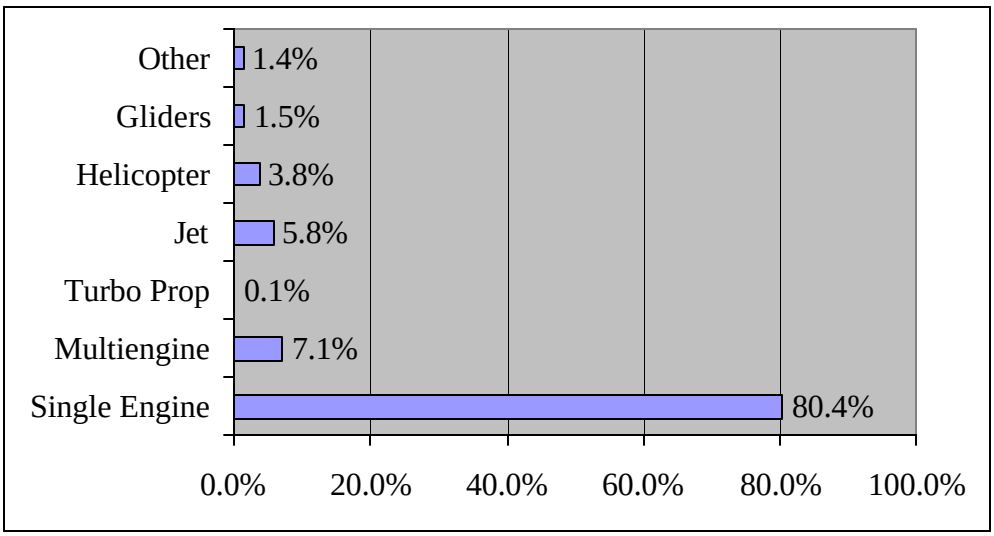


Table 2.20
MAG Based Aircraft Fleet Mix – 2025

Facility	Single Engine	Multi Engine	Turbo Prop	Jet	Helicopter	Gliders	Other	Total Based Aircraft
Buckeye Municipal	90	0	0	8	17	0	17	132
Chandler Municipal	681	49	0	35	31	11	0	807
Estrella Sailport	0	0	0	0	0	23	0	23
Gila Bend Municipal	10	0	0	0	0	0	0	10
Glendale Municipal Airport	321	22	0	6	6	2	7	364
Memorial	14	5	0	0	0	0	0	19
Mesa Falcon Field	1,395	51	0	40	100	0	0	1,586
Phoenix-Deer Valley	1,818	149	0	73	41	3	0	2,084
Phoenix-Goodyear	544	45	0	26	12	15	15	657
Phoenix-Sky Harbor International	10	25	0	85	15	0	0	135
Pleasant Valley	38	0	0	0	0	46	32	116
Scottsdale Municipal	281	75	0	93	20	2	2	473
Sky Ranch Carefree	186	35	0	0	0	2	7	230
Stellar	241	20	7	8	5	5	5	291
Wickenburg Municipal	48	3	0	3	4	2	0	60
Williams Gateway	180	36	0	43	27	0	15	301
System-wide	**5,857**	**515**	**7**	**420**	**278**	**111**	**100**	**7,288**
	80.4%	7.1%	0.1%	5.8%	3.8%	1.5%	1.4%	

Source: Maricopa Association of Governments, Airport Operator Estimates

Total Aircraft Operations Projections

The projection of operational demand is critical to determining the need for airside improvements throughout the MAG airport system. Total operational demand projected in this section consists of several types of activity including commercial air carrier (including major/national and regional/commuter operations), air taxi, military, and general aviation.

Four methodologies were used to project total operations for the MAG airport system to ensure a reasonable forecast. One methodology examined historic growth in operations within the MAG airport system. The second methodology examined the number of operations per based aircraft at each airport in the MAG airport system. A third methodology projected airport operations based on the growth rates identified in the various airport master plans prepared for MAG system airports. The final methodology examined the growth rate of U.S. towered airport operations. **Table 2.21** presents historic and projected operations at MAG system airports based on these methodologies, as discussed below.

Projections Based on Historic Growth of MAG Airport System Operations

The first methodology examined the historical growth in operations experienced within the MAG airport system. As shown in Table 2.21, total operations at all MAG airports grew at an average annual rate of 6.25 percent between 1996 and 2000.

Table 2.21
MAG Historic And Projected Operations

Year	Operations	Historic Growth	OPBA	Master Plans	FAA 2000-2012	TAF
Historical						
1996	1,464,318					
1997	1,586,087					
1998	1,625,766					
1999	1,802,867					
2000	1,866,069					
Forecast						
2005		2,381,630	2,194,200	2,131,270	2,102,780	2,118,500
2010		2,967,940	2,582,170	2,454,620	2,369,520	2,405,090
2015		3,610,960	2,970,130	2,857,030	2,670,100	2,730,440
2020		4,288,680	3,358,100	3,371,030	3,008,800	3,099,810
2025		4,971,760	3,746,060	4,048,700	3,390,470	3,519,140
Average Annual Growth Rate	6.25%	4.00%	2.83%	3.15%	2.42%	2.57%

Source: Maricopa Association of Governments, WSA Analysis

In projecting MAG operations growth through the year 2025, this methodology assumed that the historical growth rate experienced at MAG airports would not continue unabated during the course of the planning period. Rather, it was assumed that the average annual growth rate within the MAG airport system would gradually decrease during the course of the planning period in five-year increments. Initially, it was assumed that aircraft operations would grow in the initial five-year period at an average annual rate of 5.0 percent. Subsequent five-year intervals would see the average annual growth rate slow to 4.5 percent, 4.0 percent, 3.5 percent, and finally 3.0 percent during the final five-year interval.

This methodology results in MAG airport system operations growing from approximately 1,866,069 in the year 2000 to 4,971,760 in the year 2025. The overall growth represents an average annual rate of 4.0 percent.

Projections Based on Operations Per Based Aircraft

The second operations projection methodology also uses a bottom-up approach. This approach determined the numbers of operations per based aircraft (OPBA) at each MAG airport during the year 2000. This methodology assumed that the numbers of operations per based aircraft would remain constant throughout the planning period. The preferred numbers of based aircraft projected during the planning period were then multiplied by the numbers of year 2000 OPBA to arrive at total operations for the MAG airport system.

This methodology results in MAG airport system operations growing from approximately 1,866,069 in the year 2000 to 3,746,060 in the year 2025. The overall growth represents an average annual rate of 2.83 percent.

Projections Based on MAG System Airport Master Plans

The third operations projection methodology also uses a bottom-up approach. This approach determined the growth rate of operations projected in the various airport master plans developed for airports within the MAG system. This methodology applied the growth rates contained in the various master plans to year 2000 operations at the respective airports.

MAG airport system operations are projected to grow from approximately 1,866,069 in the year 2000 to 4,048,700 in the year 2025, based on this methodology. The overall growth represents an average annual rate of 3.15 percent.

Projections Based on FAA 2000-2012 Towered Airport Projections

The final operations projection methodology identified the growth rate identified in the *FAA Aerospace Forecasts, 2001-2012* for aircraft operations at all towered airports in the United States. A review of these FAA projections determined an average annual growth rate of 2.42 percent for all towered airports in the U.S. through the year 2012. This methodology applied the growth rate for all towered airports in the U.S. to 2000 operations at MAG system airports throughout the planning period.

This methodology projects MAG airport system operations to grow from approximately 1,866,069 in the year 2000 to 3,390,470 in the year 2025, representing an average annual rate of 2.42 percent.

Comparison With TAF

The current *FAA Terminal Area Forecast* (TAF) provides aviation activity projections for airports within the U.S. for the period 1999-2015. However, the TAF does not provide activity projections for all MAG system airports. Therefore, the growth rate determined for those MAG airports contained in the TAF was calculated and applied to the base year 2000 MAG airport system operations.

Applying this methodology results in a projection of MAG airport system operations growing from approximately 1,866,069 in the year 2000 to 3,519,140 in the year 2025. This approach results in an average annual growth rate of 2.57 percent, which is comparable to the FAA TAF growth rate for all MAG towered airports.

Preferred General Aviation Aircraft Operations Projection

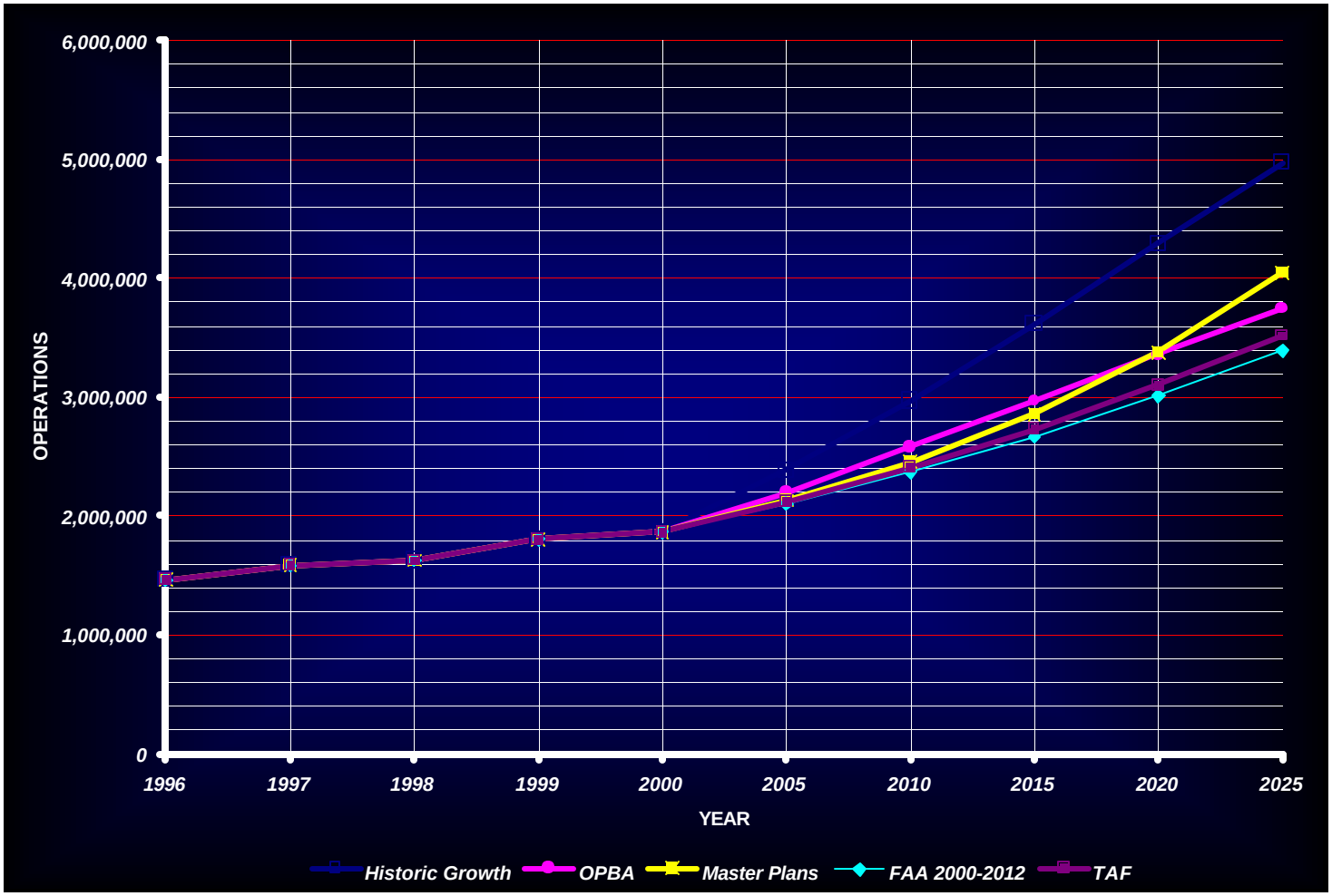
The various general aviation aircraft operations projections methodologies established a range of aviation operations levels for the MAG airport system. Operations levels ranged from a high of 4,971,761 to a low of 3,390,470. The OPBA "bottom-up" projection of aircraft operations has been selected as the preferred projection since this methodology more closely reflects actual historical activity levels at each system airport. This yields a general aviation operations projection of 3,746,060 in 2025. It should also be noted that the selected operations activity levels discussed above do not include scheduled commercial operations at Phoenix Sky Harbor International Airport or proposed commercial operations projected at Williams Gateway Airport. **Figure 2.12** graphically depicts the comparison of all the operations projections evaluated. **Table 2.22** presents the airport-specific preferred general aviation operations projections.

Table 2.22
MAG Historic and Preferred General Aviation Aircraft Projections

Facility	Historical 2000	Projected 2005	2010	2015	2020	2025	AAG Rate
Buckeye Municipal	90,000	114,230	139,480	164,730	189,970	215,220	3.55%
Chandler Municipal	249,811	286,700	343,650	400,600	457,550	514,500	2.93%
Estrella Sailport	16,500	16,500	16,500	16,500	16,500	16,500	0.00%
Gila Bend Municipal	52,000	55,280	55,900	56,520	57,140	57,760	0.42%
Glendale Municipal Airport	112,570	128,150	145,350	162,550	179,760	196,960	2.26%
Memorial	2,300	3,380	3,900	4,430	4,950	5,480	3.53%
Mesa Falcon Field	274,665	316,150	355,130	394,110	433,100	472,080	2.19%
Phoenix-Deer Valley	370,779	389,390	452,200	515,000	577,810	640,620	2.21%
Phoenix-Goodyear	142,458	173,080	213,350	253,620	293,890	334,160	3.47%
Phoenix-Sky Harbor International	72,007	70,310	63,010	55,720	48,430	41,140	-2.21%
Pleasant Valley	52,000	64,560	82,000	99,440	116,880	134,320	3.87%
Scottsdale Municipal	207,032	208,240	213,750	219,260	224,770	230,280	0.43%
Sky Ranch Carefree	4,732	6,060	7,780	9,510	11,230	12,950	4.11%
Stellar	40,880	45,840	53,980	62,110	70,250	78,380	2.64%
Wickenburg Municipal	19,846	25,950	29,000	32,040	35,090	38,140	2.65%
Williams Gateway	158,489	290,380	407,180	523,980	640,780	757,580	6.46%
Public-Use System Total	**1,866,069**	**2,194,210**	**2,582,170**	**2,970,130**	**3,358,090**	**3,746,060**	**2.83%**
Other Private-Use Airports 1/	*83,077*	*97,460*	*114,850*	*132,250*	*149,650*	*166,540*	
System-wide Total	**1,949,146**	**2,291,670**	**2,697,020**	**3,102,380**	**3,507,740**	**3,912,600**	**2.83%**

Source: Maricopa Association of Governments, Airport Operator Estimates, Wilbur Smith Associates
Note: 1/ Operations for the other private-use airports were derived by applying the OPBA ratios to the existing and projected based aircraft figures for these airports.

Figure 2.12
MAG Historic and Preferred General Aviation Aircraft Projections



Source: Maricopa Association of Governments, Airport Operator Estimates, Wilbur Smith Associates

Local/Itinerant General Aviation Operations Projections

The split between local and itinerant operations was projected for each of the MAG system airports. The FAA defines local operations as operations performed by aircraft that:

- Operate in the local traffic pattern or within sight of an airport
- Are known to be departing for or arriving from flight in local practice areas located within a 20-mile radius of the airport
- Are executing simulated instrument approaches in low pass at an airport

Itinerant operations are all other operations. **Table 2.23** presents the existing local/itinerant splits for the MAG system airports. Accurate historical splits were not available for the non-towered airports. For purposes of this study, the local/itinerant split was kept static throughout the planning period. Projected local and itinerant operations for 2025 are presented in **Table 2.24**.

Table 2.23
MAG Local/Itinerant General Aviation Operations - 2000

Facility	Local Operations	Percent	Itinerant Operations	Percent	Total Operations
Buckeye Municipal	63,000	70.0%	27,000	30.0%	90,000
Chandler Municipal	172,302	69.0%	77,509	31.0%	249,811
Estrella Sailport	16,500	100.0%	0	0.0%	16,500
Gila Bend Municipal	51,500	99.0%	500	1.0%	52,000
Glendale Municipal Airport	70,577	62.7%	41,993	37.3%	112,570
Memorial	115	5.0%	2,185	95.0%	2,300
Mesa Falcon Field	129,447	47.1%	145,218	52.9%	274,665
Phoenix-Deer Valley	198,407	53.5%	172,372	46.5%	370,779
Phoenix-Goodyear	79,440	55.8%	63,018	44.2%	142,458
Phoenix-Sky Harbor International	14,589	20.3%	57,418	79.7%	72,007
Pleasant Valley	52,000	100.0%	0	0.0%	52,000
Scottsdale Municipal	85,457	41.3%	121,575	58.7%	207,032
Sky Ranch Carefree	0	0.0%	4,732	100.0%	4,732
Stellar	31,069	76.0%	9,811	24.0%	40,880
Wickenburg Municipal	1,985	10.0%	17,861	90.0%	19,846
Williams Gateway	106,199	67.0%	52,290	33.0%	158,489
Public-Use System Total	**1,072,587**	**57.5%**	**793,482**	**42.5%**	**1,866,069**
Other Private-Use Airports	*47,751*		*35,326*		*83,077*
System-wide Total	**1,120,338**	**57.5%**	**828,808**	**42.5%**	**1,949,146**

Source: Maricopa Association of Governments, Airport Operator Estimates

Table 2.24
MAG Local/Itinerant General Aviation Operations – 2025

Facility	Local Operations	Percent	Itinerant Operations	Percent	Total Operations
Buckeye Municipal	150,650	70.0%	64,570	30.0%	215,220
Chandler Municipal	354,870	69.0%	159,630	31.0%	514,500
Estrella Sailport	16,500	100.0%	0	0.0%	16,500
Gila Bend Municipal	57,200	99.0%	560	1.0%	57,760
Glendale Municipal Airport	123,490	62.7%	73,470	37.3%	196,960
Memorial	270	5.0%	5,210	95.0%	5,480
Mesa Falcon Field	222,490	47.1%	249,590	52.9%	472,080
Phoenix-Deer Valley	342,800	53.5%	297,820	46.5%	640,620
Phoenix-Goodyear	186,340	55.8%	147,820	44.2%	334,160
Phoenix-Sky Harbor International	8,340	20.3%	32,800	79.7%	41,140
Pleasant Valley	134,320	100.0%	0	0.0%	134,320
Scottsdale Municipal	95,050	41.3%	135,230	58.7%	230,280
Sky Ranch Carefree	0	0.0%	12,950	100.0%	12,950
Stellar	59,570	76.0%	18,810	24.0%	78,380
Wickenburg Municipal	3,810	10.0%	34,330	90.0%	38,140
Williams Gateway	507,630	67.0%	249,950	33.0%	757,580
Public-Use System Total	**2,153,180**	**57.5%**	**1,592,880**	**42.5%**	**3,746,060**
Other Private-Use Airports	*95,720*		*70,820*		*166,540*
System-wide Total	**2,248,900**	**57.5%**	**1,663,700**	**42.5%**	**3,912,600**

Source: Maricopa Association of Governments, Airport Operator Estimates, Wilbur Smith Associates

Commercial Air Service Projections

This section of the working paper presents commercial air service projections for MAG system airports. New forecasts of commercial service activity are not included in the scope of this study. The projections presented in this section have been derived from the forecasts prepared for the existing and proposed commercial service airports serving and projected to serve the MAG region. However, the forecasts that have been developed for commercial service activity within the MAG region will be extrapolated through the year 2025 planning period.

Scheduled commercial air service in the MAG region is currently provided at Phoenix Sky Harbor International Airport. Williams Gateway Airport is projected to obtain commercial air service within the time frame of this Regional Aviation System Plan Update. Sky Harbor International Airport's air trade area (i.e., the geographical area it serves) extends throughout northern and south central Arizona. An airport's air trade area is usually influenced by geographical and access considerations, the proximity of alternative competing commercial service airports, arid the level and type of commercial air service provided at the airport. Tucson International is the closest alternative commercial service airport to Phoenix; the other commercial service airport in southern Arizona is in Yuma on the California-Arizona border. Tucson is approximately two hours south of Phoenix and Yuma is four hours to the southwest.

A mix of major/national and regional/commuter carriers serves Phoenix Sky Harbor International Airport. Airlines are classified into one of the following four groups: major, national, regional, or commuter. These four are defined as follows:

- A ***major*** carrier is classified as an airline with yearly gross operating revenues over $1 billion.
- A ***national*** carrier is classified as an airline with yearly gross operating revenues between *$75* million and $1 billion.
- A ***regional*** carrier is classified as an airline with yearly gross operating revenues below *$75* million.
- A ***commuter*** carrier is not related to yearly gross operating revenues, but rather the type of equipment operated and schedule frequency. A commuter carrier uses aircraft with fewer than 60 seats and performs at least five weekly scheduled round trips between two or more points.

Major and national carriers are generally classified together for reporting purposes, with regional and commuter carriers also classified together. The combined classification categories are related to operational similarities associated with aircraft types, schedule frequencies, and the types of markets served.

Commercial airline activity has been projected in terms of passenger enplanements and airline operations. Projections of commercial air service activity are important because not only do they provide a basis for determining terminal area requirements at the specific airport where they occur, the associated operations must also be considered in the overall activity levels within the MAG region.

The commercial air service projections developed for Phoenix Sky Harbor International Airport by Leigh Fisher Associates have been used for this study. Leigh Fisher Associates prepared a Primary Forecast Analysis for Phoenix Sky Harbor International Airport in 1996. This analysis was reviewed and updated by Leigh Fisher Associates in 1999.

1999 Forecast Review and Update

A review of aviation activity at Phoenix Sky Harbor International Airport since 1995 (the base year of the May 1996 forecasts) was conducted in November 1999. This review included a comparison of historical and forecast activity between 1995 and 2000. An evaluation of the key factors affecting aviation activity during this period was also undertaken. Revised annual forecasts were prepared for enplaned passengers, air cargo, and aircraft operations at Sky Harbor for 2000, 2005, and 2015, based on this review.

The following represent pertinent observations made as a result of this 1999 review of commercial passenger activity:

- Total enplaned passengers at Sky Harbor increased an average of 4.0 percent per year from 1995 to 1999. However, the number of passengers enplaned on regional and commuter airlines exceeded all 1996 forecast levels as a result of the introduction of regional jet aircraft service.

- Total aircraft operations at Sky Harbor increased an average of 1.8 percent per year from 1995 to 1999 – equal to the growth rate assumed in Growth Scenario 1 of the 1996 forecasts—with annual variations. The addition of regional jet airline service at Sky Harbor accounted for some of the recent growth in aircraft operations.

- Maricopa County population increased an average 4.5 percent per year between 1994 and 1998 – more than twice as fast as the 2.0 percent per year projections available in 1996.

- General economic conditions in Maricopa County remained strong between 1995 and 1999. Nonagricultural employment in Maricopa County increased an average of 4.7 percent per year from 1996 to 1999.

- Average airline yield at Sky Harbor decreased between 1994 and 1997 and remained below the forecast levels. The decrease in yield, in part, reflects an increase in the average airline trip length at Sky Harbor. (Average airline yields typically decrease as trip lengths increase because the unit costs are allocated over a greater number of miles.)

- Passenger airline service continued to expand at Sky Harbor. From 1995 to 1999, the number of passenger airline departures at Sky Harbor increased an average of 3.3 percent per year. Sky Harbor also experienced an increase in all-cargo airline departures during this period – an average increase of 13.4 percent between 1995 and 1999.

- America West continues to develop Sky Harbor as its primary connecting hub. From 1995 to 1999, America West's departures at Sky Harbor increased an average of 5.5 percent per year. Southwest has maintained approximately the same number of departures since 1995, with annual variations. Connecting passengers continue to account for about 30 percent of major and national airline passenger traffic at Sky Harbor.

Leigh Fisher Associates revised the annual commercial service forecasts in 1999 to reflect two primary changes in activity at Sky Harbor, based on the results of the review of aviation activity discussed previously. The commercial airline forecasts were revised based on a key factor – the addition of regional jet service and the faster than forecast growth in the numbers of regional and commuter airline passengers The underlying forecast assumptions associated with aircraft size (seats per departure), and enplaned passenger load factor were also revised to reflect more recent data.

Enplaned Passengers

Table 2.25 presents the projection of enplaned passengers at Sky Harbor International Airport, Williams Gateway Airport, and the combined Sky Harbor and Williams Gateway enplaned passenger totals for the MAG region. The passenger enplanement levels were derived from the Airport Master Plans prepared for Sky Harbor and Williams Gateway Airports, as discussed previously. The passenger enplanement totals for the year 2025 were calculated by applying the average annual growth rates identified in the respective airport master plans and extrapolating through the year 2025. Total passenger enplanements are projected to increase from 17,601,558 passengers in 2000 at Sky Harbor, to between 31,569,600 and 39,616,100 passengers in the year 2025.

Table 2.23 presents a comparison of commercial service airports around the United States that either have comparable market characteristics to the MAG region or comparable size markets. The passenger activity levels identified on this table were compiled from the FAA TAF. A review of this table indicates that the projected 2.7 percent average annual growth rate for Growth Scenario 2 at Sky Harbor is very conservative compared to the growth rates projected in the FAA TAF for comparable airports in the United States.

Table 2.25
Historic and Projected Passenger Enplanements

	Phoenix-Sky Harbor International			Williams Gateway	MAG Region	
Years	Historical	Growth Scenario 1	Growth Scenario 2	Projected Enplanements	Growth Scenario 1	Growth Scenario 2
Historical						
1995	13,895,136					
1996	15,216,893					
1997	15,404,853					
1998	15,984,620					
1999	16,507,680					
2000	17,601,558					
Forecast						
2005		20,054,600	21,368,200	250,000	20,304,600	21,618,200
2015		23,796,500	27,844,300	1,200,000	24,996,500	29,044,300
2025		28,236,600	36,283,100	3,333,000	31,569,600	39,616,100

Source: Phoenix Sky Harbor International Airport, Leigh Fisher Associates, Williams Gateway Master Plan

Table 2.26
Comparative Airport Enplanements

Year	GEORGE BUSH INTERC'L	SAN DIEGO LINDBERG	LAS VEGAS MC CARRAN	DENVER INT'L	ORLANDO INT'L	SEATTLE-TACOMA INT'L
1991	8,616,393	5,649,071	9,351,541	13,097,747	8,712,084	8,340,866
1992	8,990,424	5,967,837	9,744,409	14,243,310	9,758,004	9,019,711
1993	9,504,540	5,883,093	10,302,840	15,038,001	10,280,218	9,258,936
1994	10,257,228	6,295,539	12,183,593	15,768,233	10,453,014	10,216,020
1995	11,494,226	6,626,050	13,019,859	14,979,616	10,584,116	11,188,640
1996	11,853,666	6,841,900	14,356,548	15,329,744	11,860,090	11,768,911
1997	12,912,612	7,087,240	14,679,958	16,237,550	13,077,471	12,066,405
1998	14,126,938	7,317,952	14,393,296	17,325,676	13,128,323	12,467,503
1999	14,996,958	7,550,495	15,630,979	18,148,611	13,780,567	13,377,182
2000	15,945,978	7,660,397	16,586,014	18,853,711	14,466,852	13,931,995
2001	16,798,696	8,001,489	17,623,180	19,615,831	15,497,776	14,526,092
2002	17,651,414	8,342,584	18,660,347	20,377,952	16,528,702	15,120,190
2003	18,504,135	8,683,678	19,697,515	21,140,074	17,559,627	15,714,288
2004	19,356,853	9,024,773	20,734,681	21,902,195	18,590,554	16,308,387
2005	20,209,574	9,365,867	21,771,849	22,664,317	19,621,480	16,902,484
2006	21,062,292	9,706,962	22,809,016	23,426,438	20,652,405	17,496,583
2007	21,915,012	10,048,056	23,846,184	24,188,560	21,683,330	18,090,680
2008	22,767,731	10,389,151	24,883,352	24,950,682	22,714,257	18,684,779
2009	23,620,451	10,730,245	25,920,520	25,712,803	23,745,182	19,278,877
2010	24,473,170	11,071,340	26,957,687	26,474,925	24,776,109	19,872,975
2011	25,325,890	11,412,434	27,994,855	27,237,046	25,807,033	20,467,072
2012	26,178,608	11,753,529	29,032,021	27,999,167	26,837,960	21,061,172
2013	27,031,329	12,094,623	30,069,189	28,761,289	27,868,885	21,655,269
2014	27,884,047	12,435,718	31,106,356	29,523,410	28,899,811	22,249,367
2015	28,736,768	12,776,814	32,143,526	30,285,534	29,930,739	22,843,468
2020	36,933,433	15,144,865	41,572,295	36,064,226	38,706,433	28,178,539
2025	47,468,054	17,951,809	53,766,837	42,945,533	50,055,160	34,759,611
Avg. Annual Growth	5.15%	3.46%	5.28%	3.55%	5.28%	4.29%

Source: FAA *Terminal Area Forecast, September 2001*

Air Cargo

Leigh Fisher Associates updated the air cargo forecasts for Phoenix Sky Harbor International Airport at the same time the commercial air service forecasts were updated. The update was undertaken due to the slower than forecast growth in air cargo activity. The underlying forecast assumptions for aircraft size and amount of cargo per departure were also revised at the time of the cargo forecast update to reflect more recent data.

The review of the commercial air service forecasts developed in 1996 revealed that total air cargo at Sky Harbor increased an average of 6.4 percent per year from 1995 to 1999, which was consistent with published forecasts of U.S. domestic air cargo growth. However, this rate was substantially less than the range of the 1996 forecast. Leigh Fisher determined that a number of factors affected the growth in air cargo during the 1995-1999 period, which were incorporated in the revised forecasts.

The Sky Harbor air cargo forecasts were prepared for both passenger and all-cargo airlines from 1999 through 2015. The air cargo forecasts included in this report for the two growth scenarios presented in the 1999 forecast update were lower than previous forecasts since total Sky Harbor air cargo remained below forecast levels for both growth scenarios since 1995.

Williams Gateway Airport also handles air cargo shipments and forecasts of air cargo activity were developed for the airport master plan update at this facility. The cargo forecasts developed for Sky Harbor and Williams Gateway Airports are included in this study. In addition, the growth rates for air cargo at these airports have been applied to the out years not forecast in the respective master plans to establish projections of enplaned air cargo tonnage. The air cargo tonnage for each airport was combined to arrive at the MAG airport system air cargo levels through the year 2025.

Total air cargo tonnage at Phoenix Sky Harbor and Williams Gateway Airports is projected to increase from 374,936 tons in the year 2000 to between 1,400,000 and 2,462,000 tons in the year 2025. **Table 2.27** presents the enplaned air cargo projections for Sky Harbor and Williams Gateway Airports and the combined airports, which serve the MAG region.

Table 2.27
MAG Historic and Projected Enplaned Cargo

	Phoenix Sky Harbor International			Williams Gateway	MAG Region	
Years	Total	Growth Scenario 1	Growth Scenario 2	Total Air Cargo	Growth Scenario 1	Growth Scenario 2
Historical						
1995	286,666			--	286,666	286,666
1996	312,842			--	312,842	312,842
1997	347,142			228	347,370	347,370
1998	366,463			345	366,808	366,808
1999	365,543			521	366,064	366,064
2000	374,150			786	374,936	374,936
Forecast						
2005		500,700	575,700	6,170	506,870	581,870
2015		831,300	1,186,500	10,280	841,580	1,196,780
2025		1,385,400	2,445,400	14,681	1,400,081	2,460,081

Source: Phoenix Sky Harbor International Airport, Leigh Fisher Associates, Williams Gateway Master Plan

Commercial Air Service Operations

Table 2.28 reflects the commercial air service operations for Phoenix Sky Harbor International Airport, Williams Gateway Airport, and the combined totals for these airports. Commercial air service operations are projected at Williams Gateway Airport during the course of the study period. This table includes air carrier, air taxi/commuter, air cargo, and military operations. The operational levels for the respective

airports were derived from the master plans for each airport. The year 2025 operations levels were derived by applying the master plan growth rates and extrapolating. The combined operations of the two airports represent total MAG system commercial air service.

Table 2.28
MAG Historic and Projected Commercial Operations

	Phoenix Sky Harbor International				MAG Region	
Years	Historical	Growth Scenario 1	Growth Scenario 2	Williams Gateway	Growth Scenario 1	Growth Scenario 2
Historical						
1995	437,671			--		
1996	457,162			--		
1997	461,519			--		
1998	475,890			--		
1999	476,327			--		
2000	503,574			--		
Forecast						
2005		546,400	582,200	6,200	552,600	588,400
2015		604,400	695,800	27,500	631,900	723,300
2025		673,300	841,000	56,020	729,320	897,020

Source: Phoenix Sky Harbor International Airport, Leigh Fisher Associates, Williams Gateway Master Plan

Historic and projected total commercial service aircraft operations are provided for both Sky Harbor and Williams Gateway Airports on Table 2.28. Two growth scenarios were developed for operations at Phoenix Sky Harbor International Airport for each component of aviation activity. Therefore, total commercial service operations within the MAG system likewise have two growth scenarios. Total operations in Growth Scenario 1 are projected to increase from 503,574 operations in 2000 to 729,320 in 2025, representing an average annual growth rate of 1.51 percent. In Growth Scenario 2, total commercial service operations are projected to increase 2.71 percent per year to 897,020.

Military Aircraft Operations.

The majority of the military operations in the MAG region occur at Luke Air Force Base. While not part of the civilian airport system that serves Phoenix, the role of Luke is integral to the MAG RASP's analysis. In addition to Luke, Phoenix Sky Harbor International maintained approximately 10,000 military operations from 1970 through 1995, with year-to-year variations.

Because military activity varies with the political climate and variation in government funding of the military, military operations at Luke and Phoenix Sky Harbor International were held constant at 168,000 and 10,000, respectively (see **Table 2.29**).

Table 2.29
MAG Historic and Projected Military Operations

Years	Luke AFB	Phoenix Sky Harbor Int'l	Total
Historical			
1989	231,653	8,106	239,759
1990	233,892	8,703	242,595
1991	183,950	7,267	191,217
1992	137,480	10,909	148,389
1993	123,438	17,412	140,850
1994	153,587	8,917	162,504
1995	158,185	8,637	166,822
1996	not on record	5,412	N/A
1997	146,319	5,253	151,572
1998	161,000	4,688	165,688
1999	168,521	3,766	172,287
2000	194,054	4,265	198,319
Forecast			
2005	168,000	10,000	178,000
2015	168,000	10,000	178,000
2025	168,000	10,000	178,000

Source: Phoenix Sky Harbor International Airport, Luke AFB Personnel

SUMMARY

This working paper has presented forecasts of aviation activity for the MAG region, including based aircraft, general aviation operations, enplanements, commercial operations, and military operations. **Table 2.30** summarizes the overall projections for the MAG region.

Table 2.30
Summary of MAG Region Historic and Projected Activity

Years	Based Aircraft	GA Operations	Commercial Operations	Military Operations	Enplanements	Air Cargo
Historical						
1996	3,548	1,949,146	457,162	N/A	15,216,893	312,842
1997	3,682	1,586,087	461,519	151,572	15,404,853	347,370
1998	3,816	1,625,766	475,890	165,688	15,984,620	366,808
1999	3,952	1,802,867	476,327	172,287	16,507,680	366,064
2000	4,317	1,949,146	503,574	198,319	17,601,558	374,936
Forecast						
2005	4,820	2,291,670	588,400	178,000	21,618,200	581,870
2015	6,215	3,102,380	723,300	178,000	29,044,300	1,196,780
2025	7,612	3,912,600	897,020	178,000	39,616,100	2,460,081

Source: Maricopa Association of Governments, Airports, Wilbur Smith Associates